TP 4048E

EYRETECHNICS LIMITED

REPORT ON

THE TRIAL STAFF AND SUPPORT SERVICES

FOR AIR CUSHION ICE-BREAKING BOW

TESTING AND EVALUATION TRIALS

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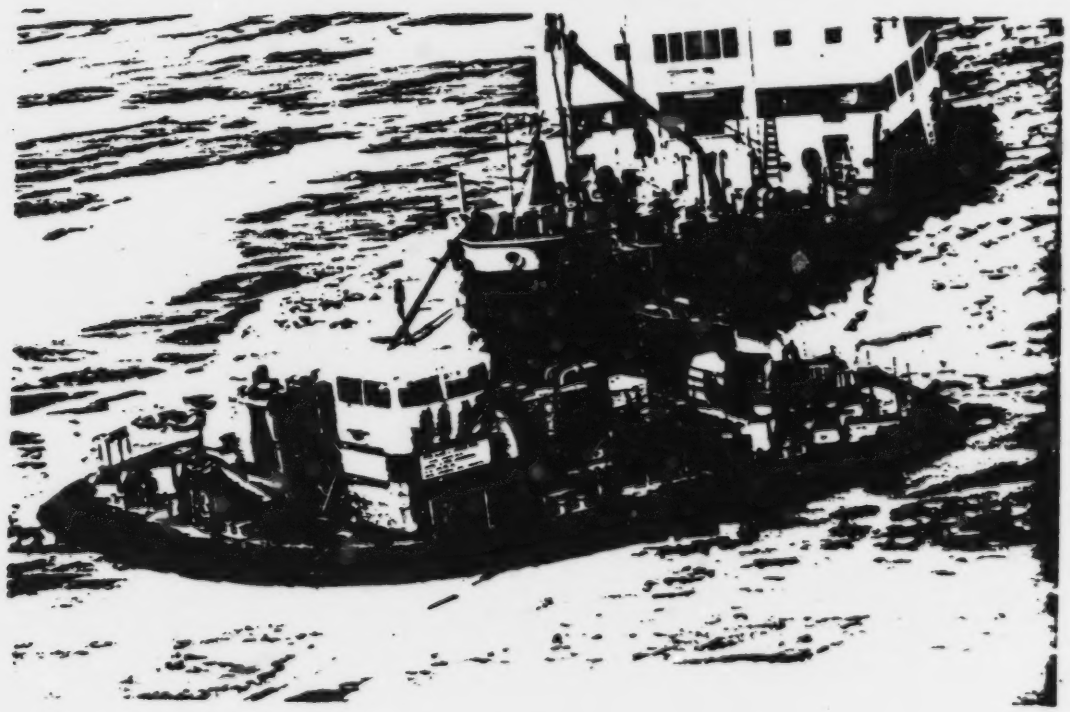
EYRETECHNICS LIMITED

JULY 1982



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TRIAL STAFF AND SUPPORT SERVICES FOR AIR CUSHION - ICE-BREAKING BOW TESTING AND EVALUATION

1. OBJECTIVE

Eyretechnics is to provide test site personnel, material, equipment and general support services to assist TDC in the testing and evaluation of the air cushion ice-breaking bow at Thunder Bay, Ontario, under contract 10SD.T8200-1-1565.

2. SCOPE

Eyretechnics is to provide personnel for the maintenance and operation of the ACIB at Thunder Bay, procure shelter and equipment for the ACIB test base, and provide supplies and services, as required by TDC for the conduct of the trials.

3. WORK CARRIED OUT

Eyretechnics personnel arrived at the ACIB in Port Arthur Shipyards, Thunder Bay, on 23 February 1982 to begin setting up the base of operation and part of the operation and maintenance of the ACIB. Due to delays and problems with the notch and hydraulic systems, a secondary base was set up at Port Arthur Shipyards in the form of a 10' x 16' trailer. The primary base was to be set up at Keefer Terminal beside the Canadian Coast Guard Sub Base but because of the problems with the craft this was delayed.

The necessary personnel were hired in Thunder Bay and training started on the ACIB, as much as was possible at the time. Due to the heavy work load it was deemed necessary to bring in a technologist from Eyretechnics' Atlantic office, to aid the project manager and also to provide his expertise in hydraulics to help overcome some of the problems with the system and bring it to operational status. Problems like control head failure and sticking valves can be attributed directly to the fact that the craft sat in Calgary without maintenance for more than a year.

In general, the project manager and the hired personnel were kept busy procuring and installing equipment as per Test Director's instructions, as well as operating and maintaining the ACIB. The following installations were carried out:

- fire extinguishers in the howdah
- life rings around the ACIB perimeter
- first aid kit
- fire axes
- signs
- enclosures of lower howdah
- new bronze sounding plugs
- life raft
- notch winches

- wear skirts
- new winch cable
- new RACOR fuel filter, brackets and fuel lines
- communications system
- engine lub oil drains
- cold start kits on engines
- alarm systems for hydraulics
- balance line changed from 3/4" to 1-1/2" pipe
- gauge panels on each hydraulic power pack
- new trim ballast tanks
- cargo netting with weighted chain on notch
- trim ballast tanks, main fuel line, engine exhausts, hydraulic power pack frame, emergency fuel tank, life raft stand painted to minimize rust.

Although there were maintenance problems throughout the tests the major problem was the skirt system. A catastrophic failure occurred in the skirt system causing an end to the testing. For a detailed description of the damage, see Appendix A. Once this was repaired the ACIB was beached and all rented equipment was returned. A 10' x 13' prefab building was erected beside the ACIB to house the remaining spares and equipment (see Appendix F for complete inventory). The ACIB was checked out and run for the last time on the 21 June 1982. For a detailed account of the work carried out and the problems encountered see Appendix B and Appendix C, a copy of the ACIB log.

4. RELIABILITY

Based on experience, the ACIB log, and detailed inspections, the reliability of the craft is very poor when operating in ice. The major part of the reliability problem seems to be the present skirt system. It appears that the ice can dislodge the support tubes from their lock pins without much difficulty. Compounding the problem is the fact that aluminum support tubes have one third the stiffness of steel tubes. A breakdown on reliability by major component has been done and can be found in Appendix D. Also the results of the detailed inspection of 26 May 1982 can be found in Appendix E. This will give the reader an idea of the problems encountered on the ACIB.

5. MAINTAINABILITY

The 1982 set of winter trials has pointed out areas on the ACIB which could greatly increase the ease with which the craft could be maintained as well as increase the safety and reliability. At the present some standard checks are hard to do and during winter operations would tend to be ignored or forgotten. For example, the check of engine coolant must be done by climbing up onto the top of the engine compartment. There is no provision to climbup. Another example is the present set of handrails. Because the rails are threaded they are very weak in the area of the thread. For this reason several have broken off on the bow of the ACIB. They take a lot of time and effort to repair and require specialized equipment. There are many other points found in Appendix G which, if implemented, would greatly enhance not only maintainability but also safety and ease of operation.

6. CONDITION OF ACIB

As of 22 June 1982 there are 63 listed defects on the ACIB. This does not include suggested changes or additions which would put the number above 150. This may sound alarming but actually the 63 defects are, for the most part, small problems which should be fixed but which do not create a large hazard.

6.1 Skirt Segments

The main problem, as mentioned several times throughout this report, is the present skirt system. There are repairs to it which must be done before the ACIB can even go up on cushion again. If they are not done, another catastrophic failure will occur. There are three support tubes off their lock pins as well as several tears in other skirt segments. The added material on the repaired bow segments is not as strong as the original material. Another fact is that the #33 skirt segment had been repaired at P.A.S. with the same material and #33 was completely shredded during the bow damage with none of the repair material remaining.

6.2 Engines and Fans

The engines and fans on the ACIB are in very good condition and as long as proper maintenance is carried out, will continue to operate with a very high reliability factor. The problems which occurred initially with them can be attributed to the lack of maintenance during the stay in Calgary. Most of these problems have been identified and rectified.

6.3 Main Structure

The main structure has a couple of minor problems which should be cleared up before next winter's trials begin. One of the problems is the result of the skirt failure in the bow. This is the two missing "T" supports. These were not replaced at the time of the repair because it was felt to be unnecessary to beach the ACIB. If the skirt system is redesigned it is expected that these will not be needed. The only other problem is the fact that there are several bolts in the main structure which are too short. This problem has not caused a general weakness of structure as such but is generally bad assembly practice. The structure can be considered quite sound and is expected to remain so for quite some time. The implementation of some of the recommendations listed in Appendix G would increase not only reliability but safety, maintainability and the life of the strucutre.

6.4 Hydraulics

There were a great deal of problems with the hydraulic system initially, but with operation, a fair amount of the problems gradually began to disappear. This group of problems - sticking valves, slow and jerky response and corroded controls - can be directly attributed to the stay in

Calgary with no maintenance for a year. The balance of the problems is design, poor assembly practices and insufficient flushing at start-up.

With the changes made in the system to date the system's reliability and maintainability have improved considerably. At present, the hydraulic system's condition could be considered good. Implementing, the recommendations as listed in Appendix G would raise the system's reliability alone up at least two points (see Appendix D).

6.5 Instrumentation and Controls

The controls work reasonably well although there are recommendations in Appendix G that, if implemented, would greatly increase the safety and ease of operation of the ACIB.

The instrumentation has problems primarily in trim circuit design. For instance, the amp gauges in the howdah do not agree with the ones on the engines or the ship's panel and the same for the ship's panel. The cushion pressure gauge does not work at all on the ship's panel. A redesign of the instrument and control systems would greatly increase reliability and maintainability of these systems as well as the maintainability and ease of operation of the craft as a whole.

6.6 Winches and Cables

At present, three of the four cables should be replaced. There are valves sticking out, which could be easily broken off, and flexible lines making walking hazardous.

The winches operate correctly and reasonably well although they could use blocks under the drum edges to prevent cables from jamming under the edge. If a more flexible cable was used and Port Colborne fairleads installed the system operation would improve by about three points in reliability as well as simplifying operation and maintenance.

6.7 Spray Skirt

The spray skirt is in reasonably good condition throughout, with the exception of missing cable attachments, improper fasteners used to hold each segment to the next, and some chain attachment plates pulled off. Once the spray skirts have been properly installed the system should become very reliable. See Appendix E for spray skirt damage.

6.8 Notch

The notch system works. The damage incurred on the notch system has occurred because of initial assembly problems and because of fouling on the stand during the initial launch, an accident where a notch finger was pulled loose. The portion that appears to take a beating during normal operation is the inner notch sealing fingers. It is suspected that a redesign of this finger would prevent further damage. There are still air leaks, around the carousel especially.

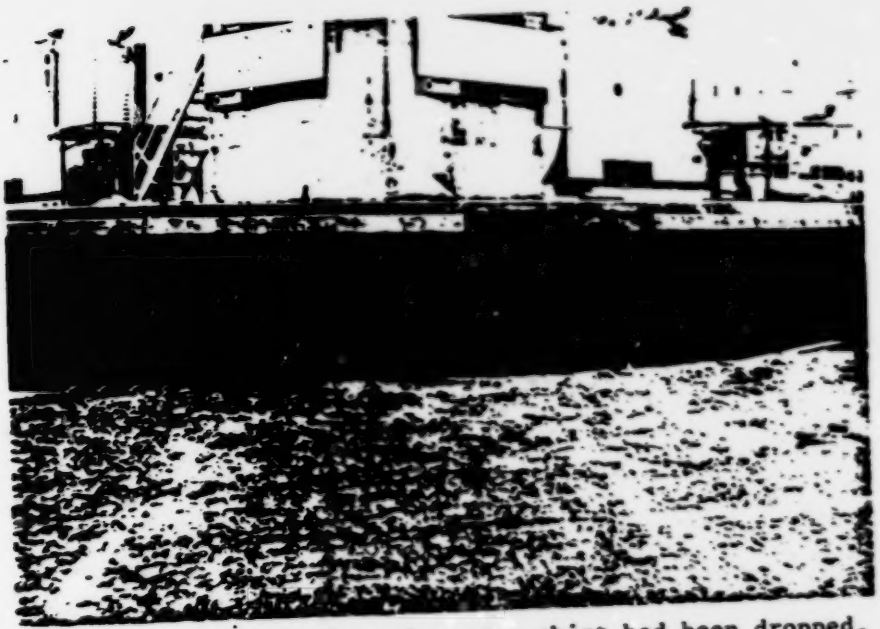
7. RECOMMENDATIONS

The recommendations are many and varied, and Appendix G covers them quite well. Appendix H also shows some sections of the ACIB along with suggestions for improvements of those sections. Appendix H follows much the same lines as Appendix G but has pictures added for clarity. To summarize the two appendices, the ACIB should be gone over thoroughly, doing redesigns in a few areas. These areas are:

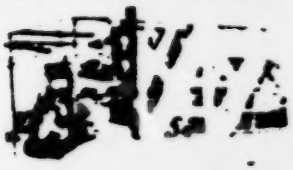
- skirt segments and attachments (most important)
- notch
- howdah
- instrumentation, controls and wiring
- engine and hydraulics enclosures
- hydraulic lines especially around winches
- cables and fairleads.

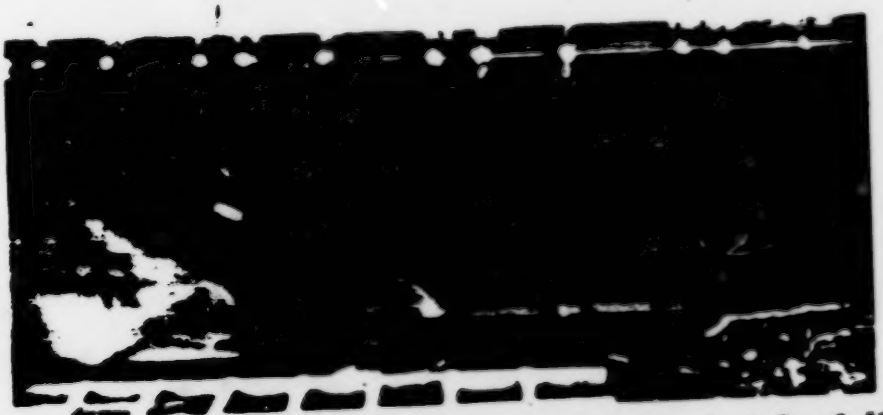
To oversimplify, redesign of the whole craft is necessary with the exception of the main structure.

Damage incurred as inspected May 2, 1982

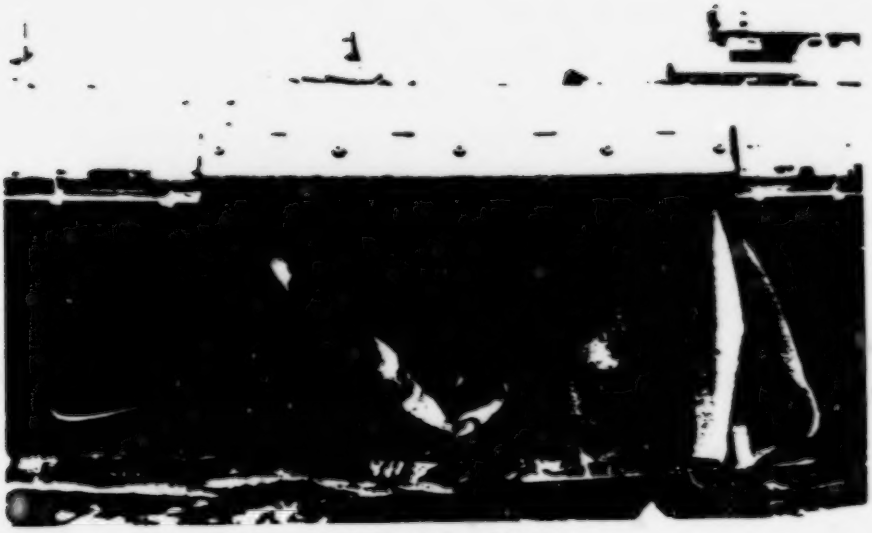


View of the damage after the spray skirt had been dropped.

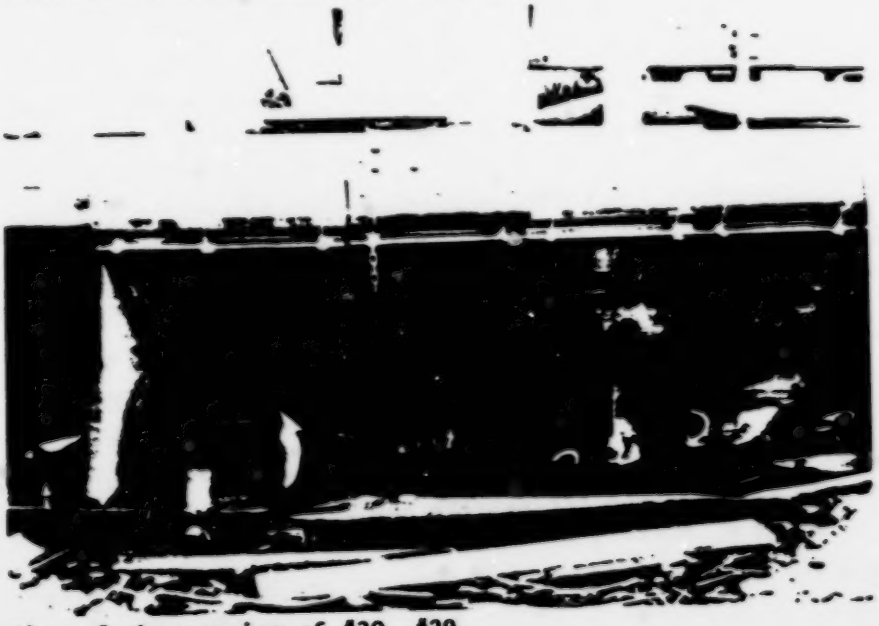




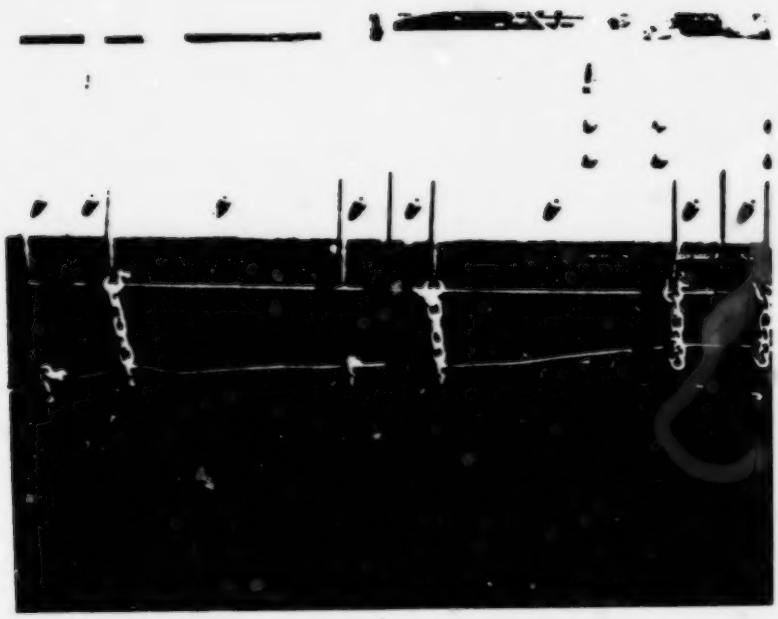
View of the tear in skirt segment #35 and what is left of #33



View of the remains of #33, #32, #31



View of the remains of #30, #29



View of attachment chain which had come loose.

Damage:

1. #35 skirt segment torn across the front.
2. #34 skirt segment has the support tube next to #33 bent near the bottom.
3. #33 is shredded beyond repair. Only the support tube next to #32 was intact.
4. #32 support bar at #31 was broken at the " T" support, as well as the front end being badly damaged.
5. The front attachment rubber was torn off #32.
6. #31 support bar at #32 was broken at the " T" support as well as the front end being badly damaged.
7. The front corner of #31 at #32 was torn down about four feet.
8. The attachment pins for #31 and #32 support bars have been torn out of their brackets and are missing.
9. The " T" support for the same two support bars was broken off and missing.

Damage cont'd.

9. The support bar of #30 at #29 was broken at the " T" support and has sustained front end damage.

10. The support bar of #29 at #30 was damaged in the same manner as #30.

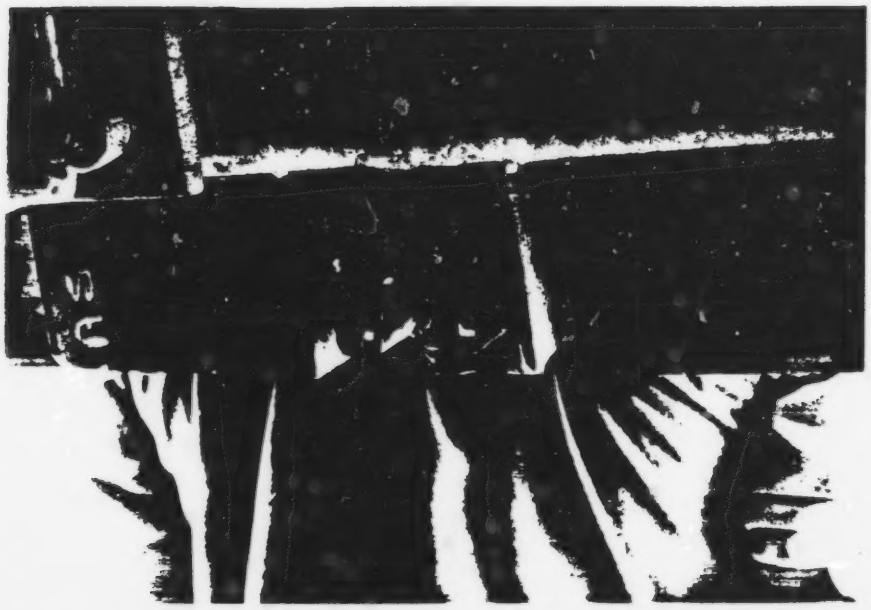
11. The attachment rubber on the front of #30 was torn off.

12. The attachment pins for #29 and #30 support tubes have been torn off and are missing.

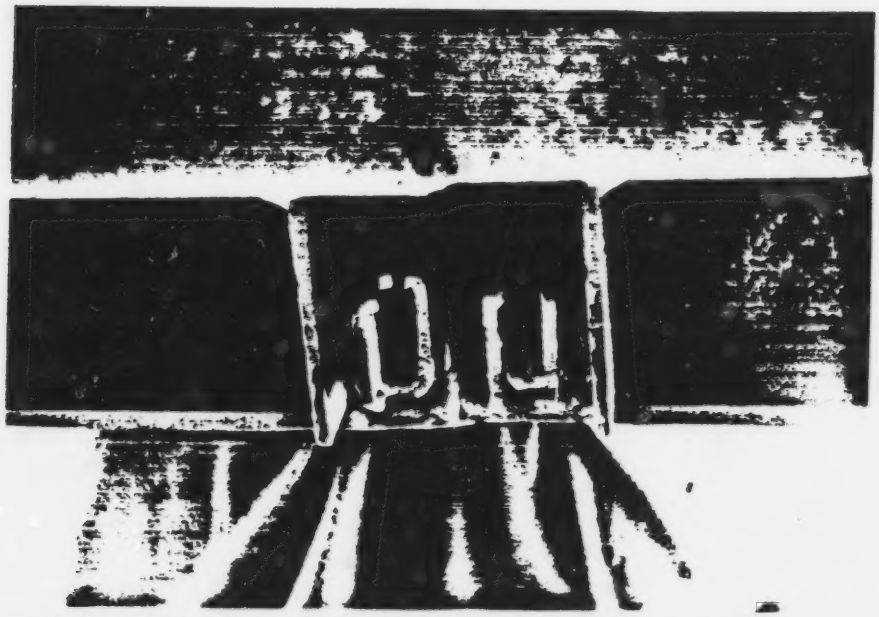
13. The " T" support between #29 and #30 was broken off and missing.

14. The attachment rubber on the front of #29 was torn off along with a two foot tear down the front.

View of support damage

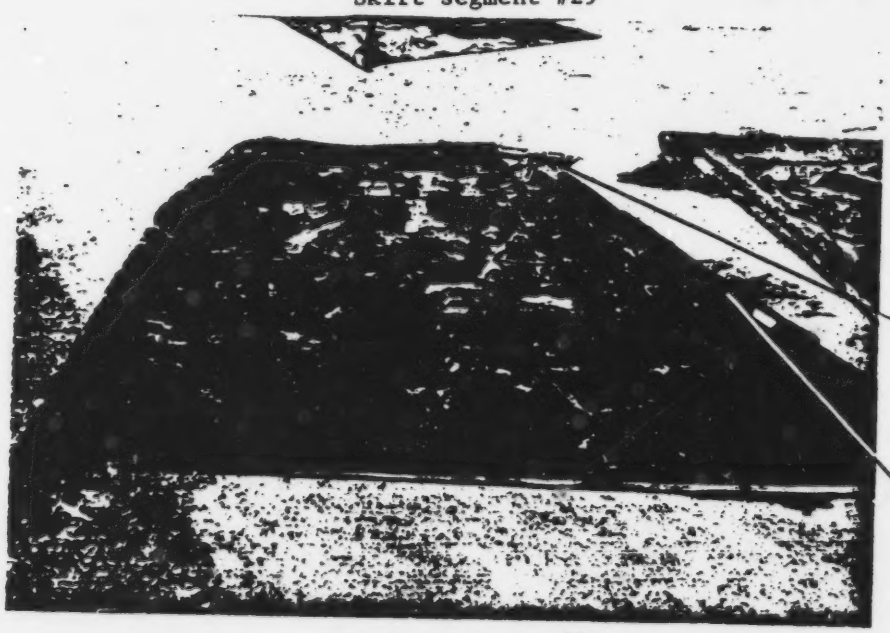


View of Lock Pin and Bracket damage for #29 and #30



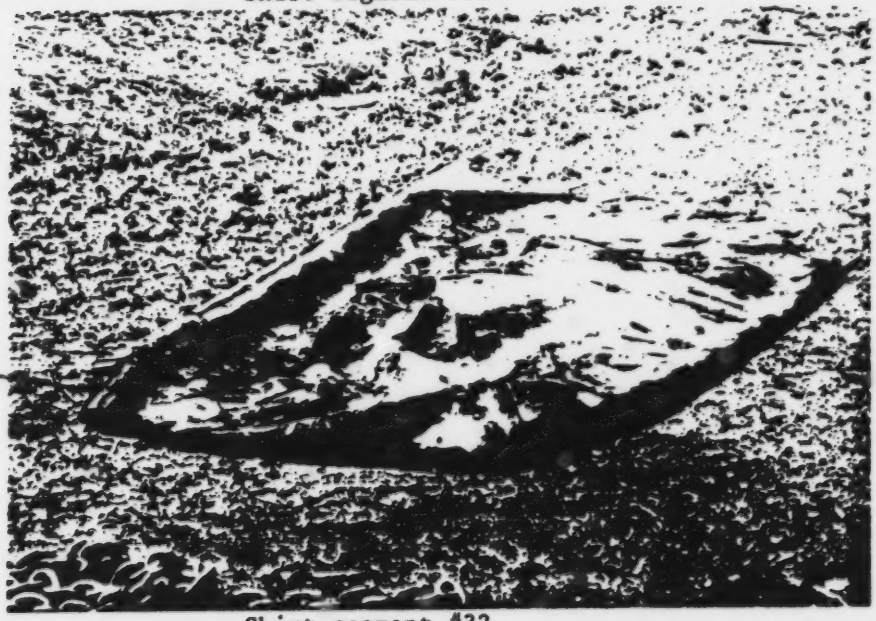
View of Lock Pin and Bracket damage for #31 and #32

Skirt segment #29



Skirt segment #30

Skirt segment #31



Skirt segment #32

Skirt Segment #33

Skirt segment badly shredded

Skirt segment #35 was only torn across the front, therefore was repaired and reinstalled. New skirt segments replaced #29, #31, #32 and #33. Old segment #31 was repaired and installed in place of the damaged #30. #34 was left in place as the tube was bent but still usable long enough to beach the ACIB.

WORK CARRIED OUT

1.0 DETAIL OF WORK CARRIED OUT

1.1 A rented Case 1450 dozer with winch capability of 72,000 pounds (320,272 N) pull was set up on the site at Keefer Terminal to be used to bring the ACIB ashore.

1.2 A 10'x40' trailer with an office (complete with telephone) at one end and a workshop/storeroom at the other was set up against the fence on the Canadian Coast Guard (CCG) Base utilizing CCG electricity and security.

1.3 Because of notch and hydraulic problems which were causing delays in testing, plus the need for a base of operation and storage facility on site, a 10'x16' trailer, furnished with six chairs, two tables and a filing cabinet, was set next to the ACIB at Port Arthur Shipyards (P.A.S.).

1.4 Personnel have been hired to aid in the operation and maintenance of the ACIB and associated test sites and equipment.

1.5 A photographer was contracted to do still and video photography of the ACIB during lauching and trials.

1.6 A van was leased for transportation and pick-up of supplies, and a larger truck was rented for a short time for the movement of equipment to Keefer and back to P.A.S.

1.7 Because of the intensity of the activity in trying to get the ACIB ready for trials, in setting up two bases of operation, and in procuring equipment and supplies, a senior technologist was brought in from Eyretechnics Limited to aid the Project Manager in setting up the operation. Use was also made of this technologist's expertise in hydraulics to help solve the many problems plaguing the hydraulic system and the electrical interface with the hydraulics. This man was also briefed sufficiently to act as backup in the unlikely event that the Project Manager had to be absent from Thunder Bay for a short period of time.

1.8 The technologist, Patrick Ambrose, filed a report on the hydraulic system as it stood 22 March 1982. A copy of this report can be found in Appendix N of this report.

1.9 Some of the defects in the above-mentioned report have been corrected since the report was filed. The corrections are as follows:

1.9.1 Defect 2(a), system pressure at 2600 psi, has been corrected by having Vulcan Machinery adjust all the pressure relief valves at its facilities in Thunder Bay down to 2200 psi. A copy of Vulcan's certificate is included in Appendix M .

1.9.2 Defect 2(c), by-pass indicators; the filters on pump #1 and #2 have been pulled and inspected. A small amount of particulate was found in one filter, and all others appeared to be clean. All filters will be changed upon arrival at Keefer Terminal.

1.9.3 Defect 2(e), equalizing line; this line has now been changed from 3/4" to 1½". This has greatly improved the ability of the system to maintain the same levels in the two hydraulic tanks. This is still a problem although a very small problem and is being closely monitored.

1.10 Port transit winch cable was repaired (new eye due to first 5 feet (1.5 m) of cable damaged), as per Test Director's instructions.

1.11 Starboard transit winch cable was replaced due to damage about mid-point of the cable, as per Test Director's instructions.

1.12 Wear aprons and hardware were obtained and they were installed, as per Test Director's instructions.

1.13 All steel sounding plugs were replaced in the bouyancy tanks with bronze plugs. The steel plugs tended to seize in the tanks, making sounding difficult.

1.14 Notch finger #1 (port side next to craft) tore during first lift-off test on 13 March 1982. Eyretechnics picked up the unassembled finger at Keefer Terminal, plus the torn finger, and delivered them to REMATECH for assembly of the former and repair of the latter.

1.15 Eyretechnics obtained chain, shackles and miscellaneous hardware for notch repair in order to help speed up the repair.

1.16 Three RACOR fuel filters were obtained, along with brackets, and one was installed on the centre engine to alleviate the fuel starvation problem caused by the original filter which plugged with water. The old filter gives no warning when it becomes plugged with water. The remaining two RACOR's to be installed upon reaching Keefer Terminal.

1.17 Eyretechnics had signs painted for the ACIB, as per the Test Director's instructions, and subsequently installed them.

1.18 The three 6 pound fire extinguishers have been installed in the howdah along with a fire axe and first aid kit.

1.19 Four life preservers and the attached position indicator light have been installed as per CCG requirements.

1.20 The fire axe has been installed on the inboard door of the centre engine.

1.21 A hard wired communications system has been installed and is working. Problems with high noise levels at high RPM's came into being. These were identified and most of them were rectified.

1.22 Boat winches have been obtained and were installed for use in opening the notch segments, to facilitate the Alexander Henry docking with the ACIB.

1.23 A complete set of operations procedures has been written for the hydraulic system including a method of operation when there has been a complete electrical failure (see Appendix J).

1.24 A tentative set of maintenance and operating instructions has been written for the rest of the ACIB including beginning-of-season inspection and maintenance and off-season inspection and maintenance (see Appendix K).

1.25 The area under the howdah has been enclosed on three sides with canvas, to act as a wind break and a protected storage area for equipment such as ropes, snatch blocks, chains, etc.

1.26 Wear aprons were installed, as per Test Director's instructions, to protect the in-notch segments #4 and #5 from chafing against the ship's side.

1.27 The remaining two RACOR fuel filters were installed along with new brackets and fuel lines. These fuel filters give a visual indication of water in the fuel; they separate this water allowing for the water to be drained away. This makes the operation of the engines in the particularly high moisture-laden atmosphere to which they are subjected a great deal more reliable.

1.28 Cold weather start kits were installed on all three engines. This not only makes it easier to start the engines in the cold but it is also easier on engine components and batteries, minimizing maintenance in these areas.

1.29 Hydraulic alarm systems were installed with warning lights and a horn in the howdah and on the ship's panel. Each light identifies itself so as to minimize time lost trouble-shooting the problem. The warning systems indicate low fluid level in the reservoir, high fluid temperature and high pressure alarm.

1.30 The balance line between reservoirs was considered too small in the area of the tanks; therefore, the fittings, lines and ball valves were increased from 3/4" pipe to 1½" pipe. This cured the tendency for one reservoir to overflow.

1.31 The hydraulic reservoirs were contaminated with water, paint and like particulate. To prevent any further damage to the hydraulics the tanks were flushed out and new fluid installed.

1.32 All of the hydraulic pressure gauges on each power pack were removed and installed on a panel mounted at the front of the enclosure frame so that they could be easily checked without endangering the person monitoring the hydraulics.

1.33 The engine lub oil drains had been removed by P.A.S. to make a tight engine enclosure for fire extinguishing purposes. This did not take into account having to change engine oil at a later time. This system was redesigned so as to maintain the previous air-tight integrity while allowing the engine lub oil to be changed with the minimum amount of problem.

1.34 Ballast tanks were built and installed at the aft end of the notch to aid in the trimming of the ACIB during the docking and undocking with the ship. The tanks carry 160 cu. ft of water and weigh 1750 pounds (794 kg) empty. Full, the tanks and water weigh 11,734 pounds (5323 kg).

1.35 Cargo netting with 1-1/8" chain for weight was installed on the end of both sides of the notch to help prevent the tendency of each notch segment to roll up at the ends.

1.36 Some of the spray skirt attachment shackles and those shackles added in the notch area were lockwired to prevent loosening during operation. This turned out to be very successful because all of the lockwired shackles are still in place while several others have been lost.

1.37 At 1330 hours, 29 April 1982, six skirt segments on the ACIB were severely damaged along with some minor structural damage. The loose rubber and metal werecut away to allow a jury rig repair to be put into place to enable the ACIB to be brought back to Keefer Terminal.

1.38 On 13 May 1982 most repairs to the skirt segments and structure were completed.

1.39 On 14 May 1982 the ACIB was hooked up to the dozer winch with the craft's notch cables. With the use of the dozer winch and the ACIB's notching winches the craft was beached on the pad successfully.

1.40 The bull dozer was returned to Case Equipment, and all cables were retracted back onto the winches of the ACIB to clear the area around the craft.

1.41 A 10'x13' prefab building was erected to house the remaining supplies and equipment belonging to the ACIB. This building was set up next to the craft at the landing site with the permission of the Port Authorities.

1.42 The CCG ship Alexander Henry transferred all life rings and the life raft from the ACIB to the Alexander Henry.

1.43 The trim ballast tanks, emergency fuel tank, life raft stand engine exhaust, support frame around the hydraulic power packs and the main fuel line have been painted to minimize rust in the highly humid atmosphere.

1.44 All rubber seals on the main fuel line were changed to the new fuel resistant seals originally supplied by P.A.S.

1.45 Thunder Bay Telephone was disconnected as of 21 May 1982 and the office trailer left to go back to Hill Supply as of 25 May 1982.

EYRETECHNICS LIMITED

ACIB SHIP'S LOG

24 FEBRUARY 1982 TO 22 June 1982

DATE:
Feb 24 1982

This log book has been opened this date for an Air Cushion Ice-Breaking Bow (ACIB) with three 16V71 Detroit diesels.

Port Engine serial no. 16VA016238 model no. 71637300
Centre Engine serial no. 16VA016239 model no. 71637300
Stbd Engine serial no. 16VA016240 model no. 71637300

Engine hour meter readings as taken upon their removal from the ACIB for shipment to Port Arthur shipyards in Thunder Bay. Readings taken by Craig Carter of EYRETECHNICS.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
221.2	123.5	188.7

DATE:
Feb 25 1982

Readings taken just prior to Eyretechnics taking over the starting of the three 16V71 diesel engines aboard the ACIB in Port Arthur shipyards in Thunder Bay

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
227.8	141.0	195.4

DATE:
Mar 12 1982

Engines were started and run for short periods while trouble-shooting the hydraulic system and electrical systems.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
242.6	155.9	205.2

DATE:
Mar 13 1982

First lift-off test with the fence between the ACIB and the aircraft covered in plywood. The ACIB was anchored in position by two bulldozers, one at the notch and one at the bow, tied to the craft with bridles.
The craft lifted off with all three engines at 1200 RPM and the Inlet Guide Vanes open. At 1800 RPM the ACIB began vertical oscillations. RPM was reduced to 1600 on the port engine only. The oscillations damped out. During a subsequent test the port notch finger (#8) ripped along the attachment plate that holds the rubber to the side of the craft. The rip ran horizontally along the attachment plate for about ten feet and vertically down from the end of the plate for about six feet. The following times were recorded .

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
247.7	161.0	210.3

DATE:
Mar 15 1982

Maintenance run was carried out on the Port engine. Centre and Stbd were run for hydraulic check.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
247.8	161.0	210.4

EYRETECHNICS LIMITED

DATE: Mar 16 1982 — Centre and Stbd engines were run for hydraulic system checkout. Electrical portion checked out satisfactorily.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
247.8	161.9	211.2

DATE: Mar 17 1982 — Centre and Stbd engines were run for hydraulic system checkout. Electrical problem has arisen.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
247.8	164.6	211.9

DATE: Mar 18 1982 — Centre and Stbd engines run for hydraulic system checkout. More problems with hydraulics. Suspect sticking valves.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
247.8	165.9	212.8

DATE: Mar 20 1982 — Engines were run to complete the final checks on the hydraulic systems. Valve sticking not as bad. Suspected cause is the fact that the system was inactive for more than a year.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
248.1	167.2	213.6

DATE: Mar 22 1982 — Centre and Stbd engines run for hydraulics. More problems with sticking valves and winch controller on Stbd winch.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
248.1	167.8	214.3

DATE: Mar 23 1982 — Stbd winch controller replaced. It was found corroded inside. This can be directly attributed to the craft sitting for over a year.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
248.7	171.8	217.2

DATE: Mar 26 1982 — Dry land tests started. Three tests carried out this date.
1st test run up to 1800 RPM (to point where vertical oscillations begin). This test was conducted with only trim ballast of 52,700 lbs (23,904 kg) on board.
2nd test run up to 1800 RPM with the addition of 72,550 lbs (32,908 kg) of ballast for a total ballast load of 125,250 lbs (56812 kg).
3rd test run up to 1800 RPM (still the point of vertical oscillations) with the addition of 26500 lbs (12012 kg) of ballast for a total ballast load of 151,750 lbs (68833 kg).

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
253.6	178.0	223.8

DATE: Mar 27 1982 — All fan bearing oil changed to Shell low therm as per Howden Fan's request. Centre engine tachometer stopped functioning. Tach changed for new one but still does not work. Problem must be in tach. sender.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
255.6	0.5	226.5

DATE: Mar 29 1982 — With the use of the MITSUI AST, two bulldozers, an attempt was made to move the craft into the water. The notch rubber hung up on the stand dragging it to the waters edge. The port engine would not restart. The problem was found to be the angle of the deck at the time (approx 8°) causing the low oil sensor to give a false reading. A temporary correction was to simply overfill the oil.

DATE: Mar 30 1982 — ACIB successfully entered the water. The Stbd transit cable broke about 50 feet from the end. This cable was being used to maintain contact with the shore and for stability but in this case the winch did not pay out as fast as the craft entered the water. Several seals in the deck blew out. The craft overran the cable between the ACIB and the tug Donald Mac subsequently catching and tearing out #33 skirt segment and damaging the support tube on #34.

The ACIB was moved over to the deck at the shear leg in Port Arthur shipyard with her own transit winches. At the dock, hover tests on water were carried out. The first three tests were with trim ballast part ballast then full ballast all successful inspite of the air leakage through the deck.

Power loss occured in the Centre engine at the end of the first set of tests. The full ballast test was repeated using only the Stbd and Port engines.

The Power loss was due to a plugged fuel/water separator filter. This filter was changed for a RACOR filter which allows visual detection of water as well as drainage.

All fuel filters on all engines changed with the exception of the fuel/water separator filters on the Stbd and Port engines as none of these were available at this time.

All bouyancy tanks were sounded at 15:00 hrs all dry.

All bouyancy tanks sounded again at 19:00 hrs all dry.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
266.0	11.8	238.0

DATE: Mar 31 1982 — All bouyancy tanks were sounded at 08:30 hrs all found to be dry.

The centre engine fuel system was purged and the engine started and ran satisfactorily.

The Port engine oil pressure switch was found to be leaking and it was subsequently changed.

The full ballast weight hover test was repeated successfully.

The ACIB moved back to the original launch site and using her notching cable successfully moved herself back ashore for skirt repairs.

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ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	271.0	20.0	246.0

DATE: Apr 01 1982 — All engines warmed up and maintenance check carried out all secure

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	271.6	20.2	246.3

DATE: Apr 02 1982 — Inspection of the skirts showed the following:

1. #33 skirt segment damaged but repairable.
2. #34 skirt segment had a bent support tube.
3. # 1 Notch segment torn in the run were it hung up on the stand.
4. Other minor damage to notch segments due to the segments hanging up on the stand at launch.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	271.9	20.2	247.0

DATE: Apr 03 1982 — Notch and skirt segments repaired. Engines run up and general maintenance check carried out.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	272.0	20.5	247.5

DATE: Apr 04 1982 — Engines warmed up with a maintenance check as well as inflating the notch segments and skirts to remove ice and snow.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBC
	272.5	21.0	248.8

DATE: Apr 05 1982 — All engines started and warmed up and a maintenance check. carried out.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	273.9	22.6	249.4

DATE: Apr 06 1982 — All engines warmed up and skirts inflated to check attachments. The ACIB moved back into the water with the aid of her own notching cables. With the use of the tug Donald Mac and the Mistusi AST the ACIB was moved around to the mouth of the Dry Dock at P.A.S. A hydraulic leak developed at the port notch winch brake adjustment valve.
The ACIB was tied up to the dock just behind the tug Thunder Cape.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	282.0	31.3	259.0

DATE: Apr 07 1982 — All engines were warmed up and a maintenance check was carried out on all systems. The skirts were inflated at 1200 RPM to break free of 1" of ice which formed over nite.
The hydraulic leak was found to be a split fitting on the check valve attached to the brake adjustment valve. The check

valve was replaced, and the system test all O.K.
Move up on hover all engines at 1500 RPM and with the aid of a snatch block attached to the Stbd transit winch fairlead moved the craft around away from the tug Thunder Cape also so that the notch is facing out into the bay.
The Bouyancy tanks were sounded at 16:00 hrs and all were found dry.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	284.1	33.5	261.1

DATE:
Apr 08 1982

All engines received a warm up run then at 1200 RPM all skirts were inflated in order to break free of 1" of ice which formed overnite.
Took the ACIB up on partial cushion, 1500 RPM, to insure all skirts were free of ice and to check the auto Inlet Guide Vane (I.G.V.) opening and closing.
The check was done as follows:

1. IGV'S switched to auto
2. Start engines
3. As engines came up to idle the IGV's opened
4. Up on hover (1500 RPM)
5. Off hover and normal shutdown
6. As engines came to a complete stop IGV'S closed.

All tanks were sounded and found dry.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	284.9	34.2	26.18

DATE:
Apr 09 1982

All engines warmed up and a maintenance check carried out

ENGINE HOUR METER READINDS:	PORT	CENTRE	STBD
	285.3	34.6	262.2

DATE:
Apr 10 1982

Engines were warmed up and a maintenance check was carried out. Soundings were taken all double bottoms and tanks were dry. This was done at 09:00 hrs
The skirts were inflated at 14:00 hrs at 1200 RPM with the ACIB going up on full cushion (1800 RPM) at about 14:30 hrs. All systems functioned normally.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	287.7	35.5	263.2

DATE:
Apr 12 1982

Engines were run up and a maintenance check carried out. Soundings were taken at 10:15 hrs with all double bottoms and tanks checking dry.
Wear aprons were installed along with winches to open the notch for ship's docking.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	288.5	36.5	263.9

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DATE: Apr 13 1982

All engines were warmed up and a maintenance check was carried out.
Soundings were taken at 09:30. All tanks and double bottoms were found to be dry.
A General maintenance cleanup was started on the engines and engine compartment.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	289.6	37.3	264.8

DATE: Apr 14 1982

Engines were warmed up and a maintenance check was carried out.
Soundings were taken at 10:15 hrs. All tanks and double bottoms were found to be dry.
Roll and Pitch tests were conducted throughout the day with various levels of ballast.
A fault occured on port engine. It was felt to be a faulty water temperature sensor as all temperatures remained within limits.
Two bow stanchions were broken off when fowled with the cable from the ALGOLAKE. One stanchion was repaired.
The tests were identified as follows:
Tests 0 → 3 were done with initial trim ballast of 12.25 metric tons.
Test 0 simple light weight hover test.
Test 1 and 2 Stbd roll tests
Test 3 pitch forward test
Test 4 → 7 were done ballast with 41.04 metric tons.
Test 4 was a level test
Test 5 and 6 were roll to Stbd
Test 7 pitch forward.
Test 8 → 11 were done ballasted with 65.56 metric tons
Test 8 level test
Test 9 and 10 roll to Stbd.
Test 11 pitch forward
Tests 12 → 15 were done ballasted to 85.76 metric tons

Note:

Those weights are the weights of the ballast on board at that particular time, not the total weight of the ACIB. The ballast weights were moved around the craft to get the desired affect, not new weight added.
Test 12 level test
Tests 13, 14, and 15 were roll to Stbd

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	294.8	42.5	270.2

DATE: Apr 15 1982

All engines were started and warmed up along with a maintenance check.
Soundings were taken at 08:00 hrs and all tanks and double bottoms were found to be dry.
The fault on the port engine has reoccurred and is still felt to be a faulty water temperature sensor as the water temperature gauges show all is normal.
Testing continued today.

Test 16 pitch forward
Test 17 roll port
Test 18 roll port
Test 19 pitch forward
Test 20 level test
Test 21 simulation engine out test. This was accomplished by all engines at 1800 RPM, close port IGV's record hover height, open port and close centre, record hover height, open centre close stdb, record hover height, open stbd.
The ACIB drifted during tests damaging two more stanchions. The drift was caused by the angle of roll which in turn caused thrust on the high side.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	303.1	47.7	274.9

DATE:
Apr 16 1982

Engines warmed up and maintenance check carried out. The fault with the water temperature sensor appears to have disappeared from the port engine.
Soundings were taken at 08:00 hrs all tanks and double bottoms were found to be dry.
The tug Thunder Cape towed the ACIB on cushion (1500 RPM) out into the harbour to meet the Ice Breaker Alexander Henry.
Docking tests were carried out between the ACIB and Alexander Henry successfully. The ACIB had only trim ballast on board.
Three docking and undocking tests were carried out. The last test the Alexander Henry pushed the ACIB around on cushion (1500 RPM).
The last two dockings were done at 1500 RPM because the stbd engine had a partially blocked fuel filter/water separator which caused a partial loss of power.
All tests were considered successful.
The Thunder Cape returned the ACIB to the dock at P.A.S.
Soundings were taken at 17:15 hrs. All tanks and double bottoms dry.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	310.1	55.2	282.5

DATE:
Apr 17 1982

Engines warmed up. Port and Stbd engine fuel filter/water separators were changed to the new RACOR filters also new fuel lines were installed.
All engines were run up to full power and were found to be running normally.
Most damaged stanchions were repaired.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	311.9	56.1	283.8

DATE:
Apr 18 1982

All engines were started and a maintenance check was carried out. Soundings were taken at 13:00 hrs. All tanks and double bottoms were found to be dry.
All fan bearing oil levels were topped up.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	312.5	56.7	284.4

DATE:
Apr 19 1982

Engines started and warmed up.
Centre tach. sensor adjusted. Centre engine tachometer gauge now working on the engine.
Ballast was installed by Jack Mathewson of P.A.S.
Ballast was not installed properly. Mathewson refused direction from Craig Carter, the person responsible for ACIB operation and maintenance of the ACIB.
Soundings taken at 09:00, all tanks dry.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	313.2	57.7	285.5

DATE:
Apr 20 1982

All engines started and warmed up along with a maintenance check being carried out.
Tarpaulin was installed around the front of the lower half of the howdah so that there would be a storage space for equipment reasonably free of spray.
A general cleanup was carried out on the craft. Exhausts which had not been installed properly on the centre and port engines were removed, pipes straightened and then reinstalled properly.
Jack Mathewson moved the trim ballast up onto the bow so that all ballast was situated between the shear blocks on the bouyancy tanks. This caused the ACIB to list to Stbd and pitch heavily toward the bow. At 13:30 hrs the measured freeboard on the bow was 2" and the stern 37". A careful attempt to come up on cushion was tried in the following manner.
All engines started and set at idol (800 RPM)
IGV's were opened with only their own inertia supplying air. The ACIB rose vertifally about 4".
The notch fingers were not fully inflated at this time.
The IGV's on the centre and Stbd were closed.
The port engine RPM was brought up to 1000. The notch fingers began to inflate properly causing an immediate nosing down of the craft the bow decking going under water.
The IGV's were closed immediately and the engines shut down.
It is felt that the present ballast arrangement is dangerous and that the craft cannot be brought safely up on cushion.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	314.0	58.5	281.3

DATE:
Apr 21 1982

Engines were started and warmed up and a maintenance check was carried out.
Soundings were taken at 09:30 hrs all tanks and double bottoms were found to be dry.
Two ballast blocks from the bow were moved back to the aft corners of the notch. The ACIB sits level off cushion. These blocks weigh 9000 lbs (4083 kg) each and the change in arm would be about 24 feet (7.3 meters)
The ACIB was taken up on cushion safely.
Once stable the ACIB is pitched forward about 2^{o}. The wear aprons were adjusted and chained together to prevent movement off the notch.
Port engine centrifugal clutch failed.
Upon inspection of all three engines clutches it was decided to

replace all three sets of clutch pads.
All pads were replaced and engines run up satisfactorily.
The ACIB was moved up on cushion first at 1500 RPM then to 1800 RPM
Pressure reading at 1500 RPM was 28.5 inches of water
at 1800 RPM was 29.6 inches of water

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	316.6	60.4	288.6

DATE:
Apr 22 1982

All engines were started and warmed up and a maintenance check was carried out.
The ACIB was brought up on cushion, RPM held at 1500.
The tug Thunder Cape towed the craft out to meet the C.C.G. Alexander Henry for notching tests with maximum ballast on board.
Notch tests were successful. Two tests were carried out of which the second test also consisted of tightening the notching cables to bring the Alexander Henry further into the notch.
The Alexander Henry moved the ACIB through the water and ice successfully.
Fuel line hooked up for refueling test each tank tested successfully.
Umbilical cord hooked up and control was switched to the Alexander Henry. The control panel on the bridge of the Alexander Henry tested successfully.
The Boarding ladder was hooked up successfully.
The Alexander Henry took the ACIB outside the break water and the ACIB successfully broke ice.
Cushion pressure over ice reached 37 inches of water. Ice-breaking operations continued to 23:30 hrs. The ACIB was shut down for the evening to allow the crew to get some rest.
The notch filler skirt segments in the centre of the notch segments was found to be torn.
Ice was measured at up to 32 inches thick but was found to be porous and soft tending to bend rather than break.
During the ice breaking run the ACIB was refueled three times in all, all successful.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	330.2	73.9	302.4

DATE:
Apr 23 1982

Engines were started and warmed up with a maintenance check being carried out.
Soundings were taken at 00:30 hrs and all tanks were found to be dry.
The ACIB sat in the water and ice attached to the front of the Alexander Henry for five hours.
At 04:00 hrs engines were started and warmed up with a maintenance check being carried out.
The ACIB was brought up on cushion and ice breaking was continued.

Upon returning inside the break water the craft was taken off cushion so that the video camera under the craft could be removed. The support arm for the camera had been bent when hit by a piece of ice. The test director attempted to loosen the craft on the ship's bow by loosening the notch cables. One cable payed out too far allowing the ACIB to slew sideways. This action caused a notch finger to be pulled loose (#5 notch segment) and having its rubber torn.
The chief engineer immediately realigned the craft with the ship.
The ACIB was then taken in to dock at Keefer Terminal.

ENGINE HOUR METER READINGS:	PORT	CENTRE	STBD
	339.1	84.4	312.8

DATE:
Apr 24 1982

All engines were started and warmed up with a maintenance check being carried out.
The craft was subsequent turned around and brought to the beaching area so that it could be hooked up to the dozer winch and an attempt be made to bring it ashore for repairs.
After two tries the craft was finally brought ashore. Due to the notch damage and leaks in the deck there was insufficient pressure to raise the craft high enough to come ashore properly.
Major damage noted as follows:

1. #5 notch segment torn from its mount
2. Rubber on #5 notch segment badly torn in several places
3. Rubber on #4 notch segment torn in places but not badly
4. Inner notch filler segment torn in several places
5. Method of attachment of spray skirt improper.
   a) Washers on bolts too small thus some sections pulled apart
   b) No inner plates on the bottom chain attachments, therefore, several plates have pulled off.
   c) Shackles missing on chains which hold spray apron on. This due to the fact that the shackles were only finger tight when installed plus vibration when on cushion.
6. Two support tubes on skirt segments #65 and #15 were off their pins.
7. Circumference of the deck leak air badly all the way around.

ENGINE HOUR METER READINGS:	PORT	CENTE	STBD
	342.1	86.4	314.8

DATE:
Apr 27 1982

Installations:

1. Cold start kits installed on all three engines
2. Lub. oil and filters changed all engines.
   15 ½ gallons (58.7 litres) of oil in each engine.
3. Lub. oil pressure switches installed on port engine.
4. Hydraulic alarm system installed and repairs carried out as follows:
   a) low fluid level alarm installed
   b) high fluid temperature alarm installed
   c) high pressure alarm installed

d) balance line modified and size increased from 3/4" pipe to 1½" pipe
e) both reservoir tanks were flushed
f) all hydraulic filters were changed
g) stbd engine #2 charge pumps pressure gauge changed
h) install panels and relocate all gauges to the panels.
i) remove lower angles to facilitate cleaning around hydraulics packages.
j) install angle and reinforcing plate on both hydraulic power pack frames.

5. Lub oil drains installed on each engine.
6. New coupling for the lub oil pressure switch installed on the port engine.
7. New ballast trim tanks installed in place of original trim ballast blocks. These tanks hold 160 cubic feet of water. Weight of tank empty is 1750 lbs (794 kg). Full the total weight of each tanks is 11,744 lbs (5327 kg).
8. Cargo netting with 1 1/8" chain attached to the bottom for weight was installed to hold notch segments down in place.
9. Some caulking was done around the circumference
10. New #5 notch segment installed and its mount repaired.
11. Wear skirts mounted permanently on the inside of #4 and #5 notch segments.
12. Notch filler segments repaired and reinstalled
13. #4 notch segment repaired.
14. Shackles lockwired in the notch as well as some around the stbd side of the spray skirt.
15. Skirt segments #65 and #15 rehooked on their pins. There will be more problems with these skirts because of the locking mechanism for holding the support tubes in place.
16. New fasteners installed to hold spray skirts together and new "D" rings on notch segments.

DATE: Apr 28 1982

All engines warmed up and a maintenance check was carried out. The ACIB was brought up on cushion at 1500 RPM and with the aid of the notching winches was successfully launched and subsequently moved along side the dock in front of the Alexander Henry.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
344.1	90.7	327.8

DATE: Apr 29 1982

Engines started and maintenance check carried out.
ACIB hooked up to the front of the Alexander Henry then came up on cushion RPM set to 1600. Alexander Henry-ACIB left the harbour to go ice-breaking.
At 13:30 hrs several front segments were damaged, #35, #34, #33, #32, #31, #30, and #29. Also several shackles and chains which hold the spray skirt are also missing in the same area.
Upon refueling, the stbd and centre fuel vents did not shut off this causing a fuel spill of about two quarts on deck.
The skirt segments with metal protruding from under the spray skirt were cut off and kept on deck to be checked later against

damaged skirts. The spray apron was shortened in the area of the damage so as to help in retaining more air.

DATE:
Apr 30 1982

Deck hands from the Alexander Henry installed a weighted canvas and cargo net over the damaged area in an attempt to contain the air so that a partial hover could be achieved so as to be able to bring the craft back to Keefer Terminal. All remaining ballast in the rear water tanks (trim ballast) was dumped so as to allow a nose down attitude to aid in retaining cushion pressure. The ACIB was brought back to Keefer Terminal successfully suffering no apparent further damage. Cushion pressure coming in held at 18.5" - 20". Due to ice conditions in the dock area the ACIB could not be moved from in front of the Alexander Henry thus was left tied to the dock for the weekend.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
358.8	105.2	342.7

DATE:
May 04 1982

All engines were started and warmed up with a maintenance check being carried out.
The ice conditions were much improved.
The ACIB was turned around off cushion and moved down the dock toward the beaching area.

ENGINE HOUR METER EADINGS:

PORT	CENTRE	STBD
359.5	106.3	343.3

DATE:
May 05 1982

All engines started and warmed up. A maintenance check was carried out this date.
With the use of the C.C.G. dock crane two sets of four ballast blocks were set up on the beaching pad to act as anchors for the ACIB during the bow repair. The craft was then partially beached nose first to allow for a reasonable area to work on the bow out of water.
The bow damage was as follows

1. #35 skirt segment has front attachment rubber torn off.
2. #34 the support tube next to #33 is bent at the bottom end.
3. #33 is completely shredded. Only the support tube next to #32 is intact
4. #32 front attachment rubber is torn off as well as the support tube next to #31.
5. "T" support between #31 and #32 is broken off and is missing.
6. Lock pins between #31 and #32 that is the pin for locking support tube from #31 and the one for locking the tube from #32 have been torn off and are missing. Also the brackets which hold the pins are broken.
7. #31 support tube next to #32 is broken in two plus damage to the front end of the tube where the lock pin had been torn out as mentioned in 6.
8. #31 has a tear down the front corner next to #32
9. #30 the front support rubber is torn off along with the support tube next to #29 being broken with the front end badly damaged.

Also the rubber is torn where the tube broke in two.

10. The "T" support for #30 and #29 support tubes is broken off and is missing.
11. The lock pins for #29 and #30 have been torn out of their brackets and are missing. The brackets are damaged beyond repair.
12. #29 front attachment rubber is torn as well as the support tube next to #30 being broken. The tube was also damaged badly at the front end where it tore out the locking pin.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
361.1	107.9	344.9

DATE:
May 13 1982

Repairs to the bow were completed as follows:

1. All damaged and missing brackets and lock pins were replaced by Vulcan Machinery.
2. #35 and #31 skirt segments were sent to REMATECH for repair. REMATECH brought them back to the ACIB after repairs had been completed.
3. #29 was replaced with a straight segment obtained from ACIB spares still held at Port Arthur Shipyards. This replacement has a sole attached while the original #29 did not.
4. #31, #32 and #33 were replaced with spare corner segments obtained from the C.C.G. storage area.
5. The #31 original which had been repaired was installed in place of the damaged #30 skirt segment.
6. Since the "T" supports were missing #31 and #32 support tubes are held in place with a chain temporarily.
7. The spray skirt attachement was shortened in this area to only the shackles.

DATE:
May 14 1982

All engines were started and warmed up and a maintenance check was carried out.

The ACIB was moved back to the C.C.G. dock at 09:30 hrs. At the dock the craft was turned around so as to prevent the notch to the beaching area. Using the transit cables the ACIB was brought notch first to the beaching area. The notching cables were then connected to the winch on the bulldozer.

The ACIB was brought up on cushion at 1500 RPM and with the use of the dozer winch and notching winches moved up onto the beaching pad. The ACIB moved up onto the pad freely and easily with absolutely no problems at all.

Once situated properly the craft was taken off cushion and all cables were retracted back onto the winches. This was done to clear the area around the ACIB and allow easy movement of equipment. The bulldozer was then sent back to CASE Equipment

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
365.7	115.7	353.7

DATE: May 21 1982

As of this date a 10' x 13' prefab building was erected to house the remaining supplies and equipment belonging to the ACIB. All rental equipment has been returned. The alarm system for the hydraulics, the indication portion to be installed on the ships panel, was completed. This accounts for the high hour reading on the centre engine hour meter because the electrical power was on for the centre engine while the ships panel was being wired and tested.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
366.0	116.0	354.0

DATE: May 28 1982

The trim ballast tanks, spare fuel tank, life raft stand, engine exhausts, support frame around the hydraulics and the main fuel line have been painted to minimize rust in the highly humid atmosphere. All fluid levels were checked and topped up were necessary, bearing oil changed for the fans. The engines were warmed up and all sytems exercised to minimize problems due to condensation and rust.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
366.3	116.3	354.3

Also all the rubber seals were changed to the new fuel resistant seals on the main fuel line.

DATE: Jun 15 1982

All engines started and warmed up. A maintenance check was also carried out on all systems. All checked out O.K.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
366.9	116.8	354.9

DATE: Jun 21 1982

All engines started and warmed up. A maintenance and running check of all systems was also carried out. All O.K. Centre engine oil pressure gauge does not work. Problem found to be a broken wire at the engine transmitter.

ENGINE HOUR METER READINGS:

PORT	CENTRE	STBD
367.2	117.2	355.3

DATE: Jun 22 1982

The results of a detailed inspection of the ACIB on the 26 May 1982 and again on the 21 June 1982 as follows:

1. #8 notch finger has two vertical tears about 2 feet long one each side.
2. #7 notch finger has one tear on the side next to #8 about 10" long.
3. #6 notch finger has two wear areas on top near the root.
4. Inner notch to hull sealing finger have rivets worn off both sides.
5. #5 notch segment inner wear skirt outboard attachment is torn loose
6. The weighted netting is broken at both ends on both sides of the notch.

7. Pushing rollers have wear damage at inboard ends.
8. Notch spray skirts have chain attachment plates torn off.
9. Extra loose chain was not removed.
10. #1, #2, and #3 spray skirt panel cables are not attached.
11. #3 is attached to #4 with a cable clamp instead of a shackle
12. There is a 12" long tear at the bottom of #3 spray skirt at #4.
13. #4, #5, and #6 spray skirt cables are not attached
14. #5 cable is pulled out of the skirt panel
15. #7 spray skirt panel is fastened to the stbd notch spray skirt chain with a cable clamp instead of a shackle
16. "D" ring missing from stbd outboard wear skirt.
17. #40 skirt segment has two tears at the top corner. One 10" along the front face and another 10" along the support tube.
18. Stbd bouyancy block at #39 and #40 skirt segment is loose.
19. #36 has a 2" long tear on the front corner.
20. The support bar on #34 is betn at the bottom and has vulcanizing peeling loose at the top.
21. "T" supports are missing between #31, #32, and #29, #30.
22. #27 has a 4" tear down the front corner.
23. The support tube on #16 is bent at the "T" support.
24. #15 skirt segment support tube is off its lock pin.
25. The support tube on #7 is off its lock pin also.
26. The tube of #3 is completely out of place and there is a 2" long tear in the front corner.
27. Some 24 v bulbs are burnt out or missing from the engine panels in the howdah.
28. Centre engine amp gauge does not work properly in the howdah.
29. Stbd engine amp gauge in the howdah does not work at all.
30. All three IGV gauges dont't work. (not hooked up)
31. Cushion pressure indicator is not calibrated.
32. Transducer for ship panel cushion pressure is U.S.
33. Some labels on the panels are missing.
34. Howdah cover leaks
35. Windows on the bow scratched.
36. Covers missing from "Platform in Control" lights.
37. Labels missing from pressure gauge.
38. Gauges should be filled with damping fluid.
39. Port transit and notch cables damaged as well as the stbd transit cable
40. New batteries needed for stbd engine.
41. Eight stanchions broken off. Seven of the eight on the bow.
42. Wheel missing from boarding ladder.
43. Some deck caulking to be replaced
44. Loose bolts under the deck
45. Skirt segment lock plate bolts missing on #19, #18, and #30 lock plates.

ACIB RELIABILITY

This is based on the craft as it stands after repairs have been completed. The craft's reliability is broken down into the reliability of each of its major components and then as a whole. The reliability of the craft will be only as good as its weakest section.

The number scale used to add clarity to the reliability chart ranges from 0 to 10. "0" reliability refers to a piece of junk with which nothing can be done. "10" reliability refers to a piece of equipment which is never expected to fail.

ACIB RELIABILITY

Major Component	Reliability
Engine and fans	8
Hydraulics	6
Instrumentation and controls	7
Winches and cables	5
Main structure	9
Notch	4
Skirt segments	2
Spray skirt	7
ACIB reliability as a whole	2

The above reliability rating is based on the writer's personal experience with the craft, the repairs that have been carried out to date, the result of the detailed inspection of 26 May 1982 and the inspection of the skirts carried out on 25 April 1982 during the repairs to the notch, as well as discussions with Edward Gerou, Chief Engineer Canadian Coast Guard who worked with the writer on the ACIB during the trials period.

EYRETECHNICS LIMITED

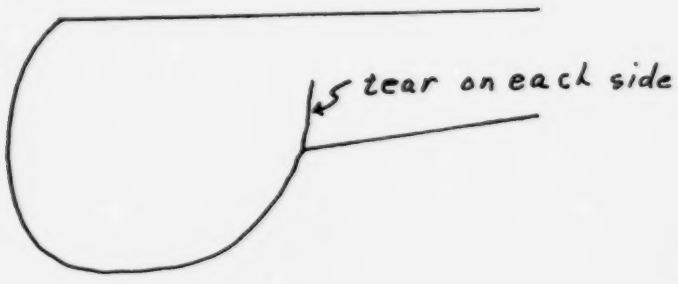
RESULTS OF DETAILED INSPECTION OF ACIB ON 26 MAY 1982

The following is a list of defects/damage as noted at the time of the detailed inspection.

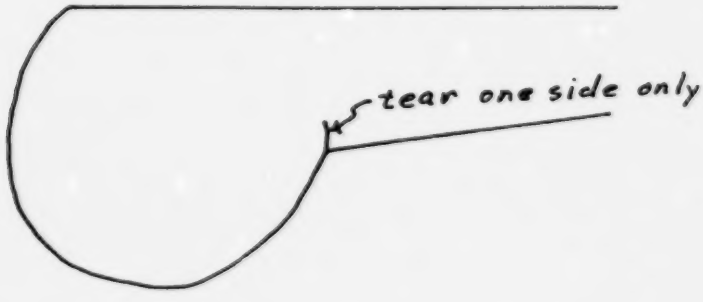
1. INSPECTION UNDER THE ACIB

1.1 Notch

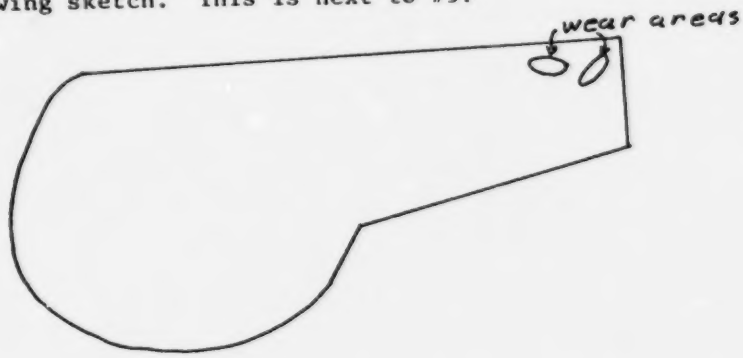
1.1.1 The #8 notch finger has two vertical tears, one on each side approximately two feet in length as per sketch.



1.1.2 The #7 notch finger has one tear on the side next to #8. This tear is approximately 10 inches long.

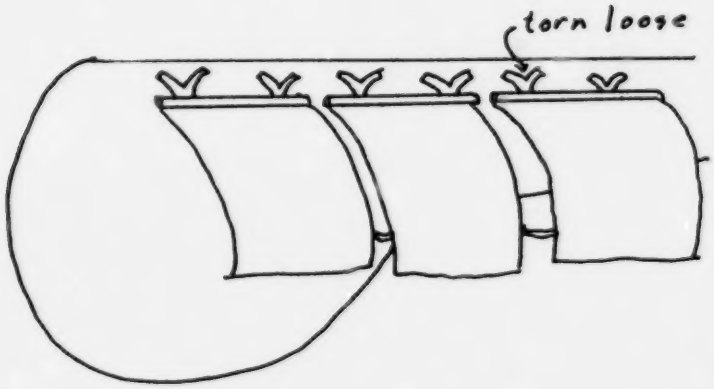


1.1.3 The #6 notch finger has two wear areas, as per the following sketch. This is next to #5.

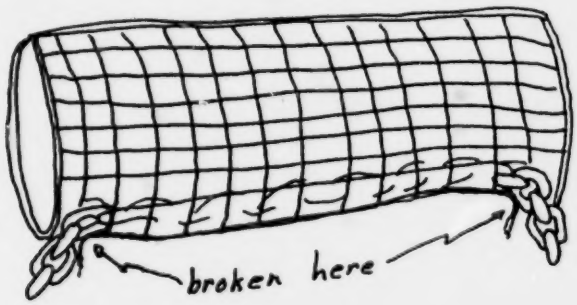


1.1.4 The inner notch to the hull sealing fingers has rivets worn off on both sides.

1.1.5 The #5 notch segment inner wear skirt outboard attachment is torn loose.



1.1.6 The weighted netting is broken at both ends on both sides of the notch.



1.1.7 The pushing rollers are damaged at inboard ends.

1.1.8 The support trusses for notch fingers have not been painted.

1.2 Spray Skirt

1.2.1 The notch spray skirt on the port side has the #4 and #5 chain attachment plates pulled off. This is due to the lack of backing plates. #4 through to #8 have no backing plates (numbered from centre of notch to port).

1.2.2 The port notch spray skirt chain is attached to the #1 spray skirt weighted cable with a cable clamp instead of a shackle.

1.2.3 The remaining loose chain was not cut off.

1.2.4 The #1 spray skirt panel cable was not attached to the #2 spray skirt panel cable.

1.2.5 The #2 cable is not attached to the #3 cable.

1.2.6 The #3 cable is attached to #4 with a cable clamp instead of a shackle.

1.2.7 There is a tear about 12 inches long at the bottom of #3 spray skirt panel at #4.

1.2.8 The #4 cable is not attached to #5.

1.2.9 The #5 cable has pulled out of the #5 spray skirt panel.

1.2.10 The #5 cable is not attached to #6.

1.2.11 The #7 cable is attached to the starboard notch spray skirt chain with a cable clamp instead of a shackle.

1.2.12 The starboard notch spray skirt chain has no backing plates for the #4 to #9 chain attachment plates (numbered from centre of notch to starboard).

1.2.13 The "D" ring is missing from the starboard outboard wear skirt.

1.2.14 All spray skirt segments with the exception of the notch spray skirts have been installed backwards.

1.3 Skirt Segments and Attachments

1.3.1 The #40 skirt segment has two tears at the top corner with #39, one tear 10 inches long along the front face and the other 10 inches long along the support bar.

1.3.2 The starboard bouyancy block at #39 and #40 is loose.

1.3.3 Skirt segment #36 has a 2 inch long tear at the top corner with #35.

1.3.4 Skirt segment #35 was repaired at the front face. The face had been torn off. Present repair is not strong enough for prolonged operation.

1.3.5 The support tube on #34 next to #33 is bent at the bottom.

1.3.6 The vulcanizing is peeling loose at the top of the same support tube mentioned in 1.3.5.

1.3.7 Skirt segments #33, #32, #31 are new segments which were installed at the time of the damage to the bow.

1.3.8 The "T" support is missing between #31 and #32. A chain is acting as support at present.

1.3.9 Skirt segment #30 was repaired along the side next to #31 at the time of the damage to the bow. Present repair is not strong enough for prolonged operation.

1.3.10 The "T" support is missing between #29 and #30.

1.3.11 At the time of the bow damage the support tube was replaced on #30 between #30 and #31. Self-tapping screws replaced the rivets at the bottom end.

1.3.12 Skirt segment #29 was replaced with a spare at the time of the bow damage.

1.3.13 Skirt segment #27 has a tear about 4 inches long down the front corner between #26 and #27.

1.3.14 The support tube on #16 between #16 and #15 is bent at the "T" support.

1.3.14 On skirt segment #15 the support tube at #16 is off its lockpin.

1.3.15 The support tube on #7 at #8 is off its lockpin.

1.3.16 The tube of #3 at #4 is completely out of place and there is a 2 inch long tear in the front corner of the same side.

1.4 Howdah

1.4.1 Some of the bulbs are burnt out in all three engine panels.

1.4.2 The centre engine amp gauge does not read properly.

1.4.3 The starboard amp gauge does not work at all.

1.4.4 The three guide vane indicator gauges do not work.

1.4.5 The cushion pressure indication is not reading properly.

1.4.6 The transducer for ship control panel cushion pressure does not work at all.

1.4.7 Some of the labels on the panels are missing.

1.4.8 The howdah cover leaks.

1.4.9 The windows are to be replaced in the howdah cover to match stiff windows installed at Port Arthur Shipyard.

1.4.10 The covers are missing from "platform in control" lights (all 3).

1.4.11 Painting is to be done inside the howdah.

1.5 Hydraulics

1.5.1 Labels are missing from pressure gauges.

1.5.2 A load check is to be carried out on transit winches.

1.5.3 The gauges are to be filled with damping fluid.

1.5.4 The port and starboard transit cables are damaged.

1.5.5 The port notch cable is damaged.

1.6 Deck

1.6.1 A new set of batteries is needed for the starboard engine.

1.6.2 Eight stanchions have broken off. Seven of the eight are on the bow.

1.6.3 The wheel is missing from the boarding ladder.

1.6.4 Some deck caulking is to be replaced.

1.6.5 There are ten loose bolts under the deck.

1.6.6 Skirt segment lock plate bolts are missing on #19, #18 and #30.

1.6.7 There isn't any paint on the corner edge rails (HSL PWG. 500-18-020 as an example), on either corners or on the bow.

1.6.8 The craft, in general, is in bad need of paint.

EYRETECHNICS LIMITED

INVENTORY OF EQUIPMENT FOR ACIB.

1. Clothing

2 pair	Coveralls
1	Parka with hood
1	Snow mobile suit
2 pair	Boots with felt liners
1	Survival suit
1	White hard hat
2	Yellow plain hard hats
2	Yellow plain hard hats with soundsuppressors
8	life jackets
Assorted pairs	Gloves

2. Tools

1	Storage Building 10'X13'
1	Crow bar
1	Hand saw
3	8" "C" Clamps
1	Soldering kit
1	9" funnel
1	2" funnel
1	Sounding tape
1	Oil can, plastic
2	Tool box
1	18" pipe wrench
1 pair	Lock-wiring pliers
1	Common screwdriver, large

Tools cont'd

1	Common screwdriver, small
1	Common screwdriver, instrument
1	Common screwdriver, stubby
1	Tap 1½" NPT
1	Tap 10-24
1	Tap ¼-20
1	Tap 5/16-18
1	Tap 3/8-16
1	Tap handle
1	Chisel, cape
1	Chisel, standard 1"
1	File, fine, 10"
1	File, course, 12"
1	hacksaw
1	Robinson screwdriver, green handle
2	Robinson screwdriver, red handle
1	Robinson screwdriver, black handle
1	15" Crescent wrench
1	1¼" Combination wrench
1	1 1/8" Combination wrench
1	1 1/16" Combination wrench
1	1" Combination wrench
1	15/16" Combination wrench
1	7/8" Combination wrench
1	13/16" Combination wrench
1	11/16" Combination wrench
1	5/8" Combination wrench

Tools cont'd

2	9/16" Combination wrench
1	7/16" Combination wrench
1	3/8" Combination wrench
2	Allen wrench set
1	Claw hammer
1	Ball pean hammer, 2 lb.
2	Wire brush
1 pair	Vise grip
1 pair	Water pump pliers
1 pair	End cutters
1 pair	Side cutters
1	Awl
1	Battery tester
1	Centre punch
1 pair	Wire stripper/crimping pliers
1	Phillip's screwdriver, #2.
1	Socket and racket set 3/8-$\frac{1}{4}$
1	V.O.M.
1	Pulley block $\frac{3}{4}$"
4	Trolleys $\frac{1}{2}$ ton SWL
1	Air pressure regulator
1	Air driven rivet gun
6	Double pulley blocks for block and tackle
3	Caulking gun
4	Snatch blocks $\frac{3}{4}$"
1	Snatch blocks 1"
1	Coal skoops, small

Tools cont'd

1	Kerosene heater
1	Spot light 6 Volts
2	Flashlights, waterproof, industrial
1	Paint brush, 2"
1	Dyno tape gun
1	Measure with flexible spout, ½ gallon
1	Hand pump, kerosene
1	Communications headset mounted in hard hat
4	Standard communications headsets
2	Extension cord 100 feet
1	Extension cord 10 feet
1	Manometer, slack tube
1	Manometer, precision

3. ACIB Spares

3	Oil filter caps for 16V71 diesels
3	Oil dipsticks for 16V71 diesels
1	Aluminum boat hook
200 feet	Rope ½"
Assorted	Chain
Assorted	Piping for ACIB fire extinguishing system
6	EP-78 filter
3	T-91 filter
3	P-28 filter
2	Brass nav. lights, red lens
Assorted	Turnbuckles
1 set	ACIB blue prints

ACIB Spares cont'd

2 cans	Quick start
1 roll	Racing tape, aluminum
1 set	Brake shoes, centrifugal clutch
Assorted	Nuts and bolts
9	cartridges, MP grease
2	linear actuators P/N 34622-1, S/N 76-3271, S/N 109-5078
1	Pressure gauge 0-3000 psi
38	Cartridges, clear silicon seal
1 set	Rocker cover gaskets
Assorted	Fuses, 24 Volt lights, fittings
Assorted	Pipe fittings
7	Shackles 12 Ton
13	Shackles ½ Ton
5	Shackles 25 Ton
14	Shackles 1 Ton
3	Shackles 8½ Ton
1	Shackles 4¾ Ton
4	Shackles 6 Ton
3	Shackles 2 Ton
1	Shackles 10 Ton
6	Cable clamps 1½"
1	Cable clamps 1"
3	Cable clamps 5/8"
2	Chain splice ¼"
1	Tarpaulin 10'X 20'

4. Fluids

12 litre	Kerosene plus container
1 litre	Paint thinner
1.7 litre	Aluminum paint
15 litre	Low therm oil
18 litre	Gear oil, 80W
1	20 litre red plastic container, gasoline
30 litre	15W40 oil

5. Cleaning Material

3	Corn broom
2	Flat shovel
1	Dust pan with small wisk
2	Garbage containers
10 lbs.	Hand cleaner
1	Pump sprayer
4.55 litre	Lotion hand cleaner
1 litre	Glass cleaner
20 litre	Degreaser

6. Trailer Equipment

1	Kettle
1	Hot plate
2	Sugar containers
1	Stool
120 ft.	10/3 electrical wire

All this equipment can be found in the storage building alongside the ACIB. All life rings and the life raft have been taken aboard the C.C.G. Ice Breaker Alexander Henry.

EYRETECHNICS LIMITED

SUGGESTED CHANGES AND REPAIRS/DEFECTS

1. STRUCTURE

1.1 At the present there is no 110 VAC supply for use of electrical tools, lights, etc. It is suggested that the 220 VAC ground power box be tapped off with outlets located at each engine.

1.2 There is an excess of wire under the howdah which should be removed.

1.3 The space under the howdah could be closed in and used for equipment stowage (snatch blocks, chains, ropes, etc.).

1.4 The hand rail posts around the circumference of the deck should be changed to a simple slip-in type, to facilitate changing damaged posts or temporary removal for gangway or skirt repairs.

1.5 At the present the deck is very slippery when wet. It is suggested a non-slip paint be used for safety reasons.

1.6 At the present the deck sealing has not been completed.

1.7 On this craft the bouyancy tanks could be divided into sections, i.e., duo tank in half and tri tanks into thirds with high speed pumps to fill, dump or transfer water for use as ballast instead of the present concrete blocks. These blocks are cumbersome and could be hazardous to equipment when put on or off the ACIB. Also, this would clean up the deck so that it may be used for carrying supplies, equipment or whatever is necessary at a particular time.

1.8 The ballast tanks at the notch need a high-capacity, high-speed pump and a larger dump valve to increase the speed of filling and dumping ballast.

1.9 The overhead cable and piping trough should be removed and the wiring and hydraulic piping located on or possibly under the decking around the edge of the bouyancy tanks.

1.10 Since the boarding ladder from the ship to the ACIB passes over the main engine fuel line, it is suggested that a ramp be installed to prevent damage to the above-mentioned fuel line as well as any other wiring or piping which may be located on the deck in the same area.

1.11 If the craft is to continue to have an emergency auxiliary fuel supply a proper tank and method of fuelling the tank, as well as a method of transferring fuel from the tank to the engine tanks, should be devised.

1.12 All unnecessary brackets and plates should be removed from the deck in order to eliminate present haszards to walking.

1.13 All brackets and plates which must remain but which are located on the deck in an area where a person could walk should be rounded or chamfered to minimize the possibility of injury (i.e., brackets which contain the ballast blocks).

1.14 Notch rollers should be redesigned. The present design does not lend itself to the self-alignment of the rollers with the ship's hull.

1.15 A proper life raft support should be designed along with an opening in the railing to allow for deployment in the unlikely event of having to abandon the ACIB.

1.16 As mentioned in paragraph 1.2 excess wire is laying under the howdah. In the event that the wiring trough is done away with, there may well be more excess wiring. It is suggested that the entire set of panels in the howdah be rewired, thus eliminating all excess wire. The excess could be retained as part of the ACIB spares for use in any future additions or as replacement for worn or frayed wires.

1.17 The howdah should be covered with plywood or metal and insulated and sound proofed. It is the writer's understanding that the present cover is for shedding ice. This canvas cover could be reinstalled over the hard cover in order to retain the ice-shedding capabilities.

1.18 A heater of some form, possibly hot water piping from the centre engine, should be installed in the howdah for those periods when it is manned.

1.19 For crew safety and to permit those aboard ship to see what is going on aboard the ACIB at night, deck flood lights should be stategically located around the ACIB so that the deck is completely illuminated without being blinding to those aboard ship.

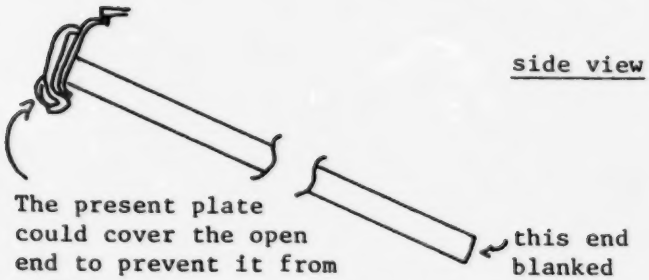
1.20 For the extra power required for such things as flood lights and power outlets for tools and extension lights it is suggested that a 10 to 20 kilowatts 110 VAC 60 Hz diesel generator unit, independent of the engines, be installed.

1.21 Due to the recent failures of skirt segment attachments and support tubes it is strongly recommended that the method of skirt attachment be completely redesigned, keeping in mind that the original specifications called for being able to change the skirt segments while the craft is in the water. A possible solution could be as follows:

round steel bar in 36" lengths inside the skirt

bolted to the craft to facilitate changing if damaged,

so that with the aid of a deck crane they could be changed in the water.



side view

The present plate could cover the open end to prevent it from coming out.

this end blanked

1.22 All present skirt segments should be closed with a sole, as are the rear skirt segments, to prevent ice damage when the ship - ACIB combination is forced to go astern.

1.23 The spray skirt should be shortened to only the double shackles all the way around the ACIB, as it is at present on the starboard side. It was noted during the last set of tests that the short side did greatly reduce the spray over the deck while still allowing excess air to spill out the top.

1.24 A mobile crane on deck would be a great asset in changing skirt segments as well as in loading equipment and spares aboard the ACIB.

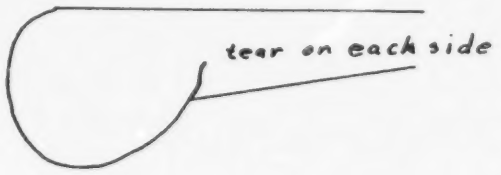
1.25 At present, approximately 25% of all bolts under the deck in the main structure are too short. Although stresses in the structure in the area of some of these bolts could still be well within safe limits, the present set-up is generally considered to be very poor practice.

1.26 Around the carousel there is still a great deal of air leakage which could be sealed. The leakage is due to the present design of the notch finger rubber attachment.

1.27 An air lock in the deck would greatly help in the inspection of the underside of the craft while on cushion over water and on and off cushion over land. This air lock could be located in the bow as there are no bouyancy blocks in this area and therefore plenty of room.

1.28 The handrail system should be redesigned to allow for removing segments in order to install a boarding ladder or gangway at random locations while moored to the dock.

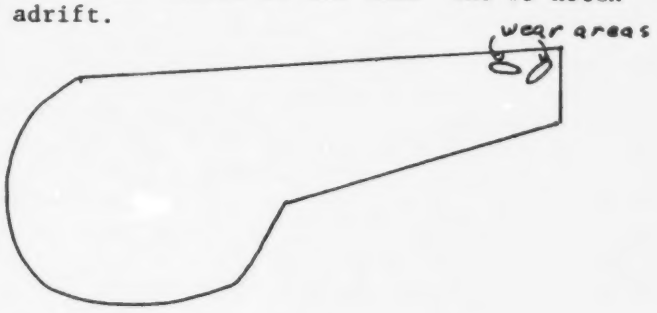
1.29 The #8 notch finger has two vertical tears, one on each side, approximately 2 feet long as per the following sketch.



These tears are believed to have occurred at the time of launch at Port Arthur Shipyard. They have not progressed any further since the launch and do not appear to hamper normal operation.

1.30 The #7 notch finger has one tear on the side next to #8. This is about 10 inches long and again has not progressed further. It should, however, be repaired.

1.31 The #6 notch finger has two wear areas, as per sketch, believed to have been caused at the time the #5 notch finger came adrift.



2. HYDRAULICS

2.1 A cover should be installed over the hydraulic packages on each engine in such a manner so as to help prevent large ice build-ups.

2.2 The reverse flow filters have no supports at present. Their only means of support is the main fitting between the pump and filter. If this fitting should fail due to vibration fatigue there would be a complete loss of hydraulic power and all the fluid would be dumped overboard before anything could be done to stop it. The filters are made to be attached to some support frame. The only thing needed to support them would be brackets welded or bolted to the cover support frame.

2.3 The ball valves on the balance line should be changed to solenoid valves which could be operated by switch and would operate automatically if one of the engines is shut down. This could prevent loss of hydraulic fluid from both engines if a hydraulic failure (i.e., broken line or fitting) occurred.

2.4 Clutches should be installed on the hydraulics so that the hydraulic package not in use could be shut down. This would greatly extend the life of the components as well as reduce maintenance.

2.5 The hydraulic tubing on each hydraulic power package should be converted to solid steel lines. This would make a much neater and easier to clean and inspect package as well as add additional support to components.

2.6 If the ball valves on the balance line are to be retained then their size should be increased or replaced by another type of valve to bring their size of opening up to the size of the pipe. This will further reduce the tendency of one tank to have a head over the other.

2.7 There should be a proper removable cover over the hydraulic lines on deck. This would protect the lines while still allowing for replacement of a line should it be necessary.

2.8 The hydraulic balance line should be changed because the present line is just a flexible rubber line laying on deck. This could be changed to a steel line of the same size which could run parallel to the main fuel line. This could also be covered to prevent damage.

3. WINCHES

3.1 There should be a cable guide installed under the flange of each drum on each side, to prevent the cable from going under the drum and causing damage to the cable. The lack of guides at the present has caused damage to both transit winch cables.

3.2 Problems have arisen with cable fouling because of cable stiffness both on the transit and notching winches. It would greatly aid operation if more flexible cables were used. They are available through Wire Rope Industries.

3.3 Due to the need for the transit cables to run at angles of 90% and greater to their normal line of travel, it is suggested that the fairleads be changed to Port Colborne fairleads which allow this type of operation as well as being always self-aligning.

3.4 The hydraulic line between the winches at present passes across the front of the winch at a height of approximately 16 inches. For safety and ease of movement around the winches these cables should be located behind the winches and on/under the deck.

3.5 The brake bleed valve and pressure valve fittings should be changed to prevent these valves from accidently breaking off and causing the winch to become inoperable.

3.6 The covers should be left off the winches to give the operator in the howdah a visual indication of the winches' motion.

3.7 Operation plaques in plastic or metal should be mounted on the winch controls to help ensure safe operation.

4. ENGINES

4.1 The coming of warm weather pointed out a cooling problem with the engines. There was not enough air flow through the engine compartment for the warmer ambient temperatures. A possible modification which would correct this problem would be a counter-balanced cooling vane which would shut off the moment the engine shut down.

4.2 The present fuel vents on the centre and starboard engine tanks do not shut off. Apparently there is a modification which should be carried out to the vents to prevent this problem from reoccurring.

4.3 The port engine has an air pump installed. It would be possible to set up the existing air tank so that the supply could be used for cleaning or operating air tools and other equipment.

4.4 The present battery installation is not very safe and is open to the weather. It is suggested that the batteries be relocated, possibly under the rear portion of the engine. This location is outside the engine compartment and also out of the weather. It would also clear the deck in that area.

4.5 To open the panels on the engine compartment doors a person must have a screwdriver. From the points of safety and convenience it would be better to have a hand-operated latch to replace the present system.

4.6 Proper brackets must be installed for the 15-pound fire extinguishers because the present brackets do not allow for quick removal of the extinguishers.

4.7 The fuel line to the port engine has been damaged but not punctured. This should be repaired. Also, a ramp should be built to prevent further damage by the boarding ladder.

4.8 Proper covers should be installed over the fire extinguisher bottles located at each engine to keep them out of the weather and to prevent ice build-up which would prevent manual firing of the extinguishers.

4.9 A means of sealing the top of each engine compartment should be devised to prevent water from entering that compartment. At the present the water from rain storms, water spray or just from ice and snow melting runs over the engines when the engines are warm.

4.10 A built-in ladder should be installed on each engine compartment to allow for servicing of intakes, exhausts and navigational lights.

4.11 A better method of sealing around the drive shaft holes in the walls of the engine enclosures should be devised to aid in retention of the fire extinguishant.

4.12 All engine tachometers should be synchronized with mechanical tack readings taken from each engine. The three tachometer pick ups on each engine do not agree with one another.

4.13 The present air vent system does not lend itself to the proper retention of fire extinguishant. It should be redesigned so it provides good ventilation as well as sealing the compartment when the engine is shut down for a fire. Possibly a system as mentioned in paragraph 4.1 would serve the purpose. or the addition of a locking solenoid which would lock the vanes closed only if the fire supression system was activated.

5. FANS

5.1 At present the guide vane actuators are wrapped in plastic for weather protection. This should be changed to a flexible rubber sleeve on the actuator arms (i.e., rubber sleeves on motor cycle shocks) and possibly a rubber or metal open-ended "sock" arrangement over the motor.

5.2 The fan inlet screens have been welded on. These should be removed and bolted in place as per the original design by Howden Fans. The present arrangement prevents servicing of the inlet guide vanes.

5.3 The fans should have an inlet deflector installed to prevent spray from entering the fan or freezing on the inlet screen and subsequently choking the fan.

5.4 The sight glass of the fan bearing at the fan inlet is broken. This should be replaced prior to any more use as there is no way to monitor the oil level in the bearing.

6. HOWDAH

6.1 The howdah should have some form of sound proofing installed because the noise level is very high due mainly to the fan intake for the centre engine being directly below and on the port side.

6.2 In conjunction with the sound proofing a hard cover (possibly plywood) could be installed so that the howdah is wind and spray proof and a heater could be installed. This would help keep the windows free of ice as well as provide a comfortable environment during periods of maintenance and during times when the ACIB must be manned.

6.3 These engines have oil temperature warnings already installed. It would be feasible to install oil temperature sensors and gauges on the engine panels.

6.4 It would be helpful as well as safer to have a warning light for each fault on the engine. This would greatly aid in diagnosing an engine fault and would give immediate indication as to engine shut down requirements. Each light could identify itself with a warning written in the face of the light. These lights are compact and easily identified at a glance. Three of these lights have been installed on the centre panel and on the ship's console for the hydraulic warning systems.

6.5 The guide vane indicator gauges have not been hooked up at the time of this writing because the circuit in the existing quide vane actuators is not the same as called for on the drawings. The circuit diagram and voltage requirements have not been identified at this time.

6.6 The centre amp gauge does not read correctly because the trim circuit is insufficient for that particular gauge.

6.7 The starboard amp gauge does not work at all and it will also need a new trim circuit.

6.8 The present engine panel configuration and installation position does not lend itself to easy reading and operation. It is suggested that a new panel be designed which is at the appropriate height and slopes for both panel visibility and visibility around the craft. Also, the engine instruments should be grouped together in such a manner as to give the operator an idea at a glance of the condition of any part of all three engines at once. For example, the three tachometers should be together as should the three throttles, so that the operator only has to look in one place for all three RPMs. A good example is the engine instrument panel in an aircraft. At the present the operator must squat down to note any instrument and must go from panel to panel. The operator cannot see out of the window and operate the throttle at the same time.

6.9 If paragraph 6.8 proves to be too expensive, a compromise to aid the ACIB through trials would be to install, on top of the starboard panel, a small panel containing the three engines at once and with a glance note the RPM.

6.10 The cushion pressure indication does not work very well because the trim circuit is inadequate. Also the method of attachment of the pressure transducers is very poor. The transducer for the ship's panel is the wrong one. The method of attachment and the trim circuit should be redesigned.

6.11 The controls for the hydraulic winches should be dead man controls. At present a control can be left in a particular position even if the operator becomes distracted or is accidently knocked off his feet, thus allowing a winch to run until the controls can be physically centred.

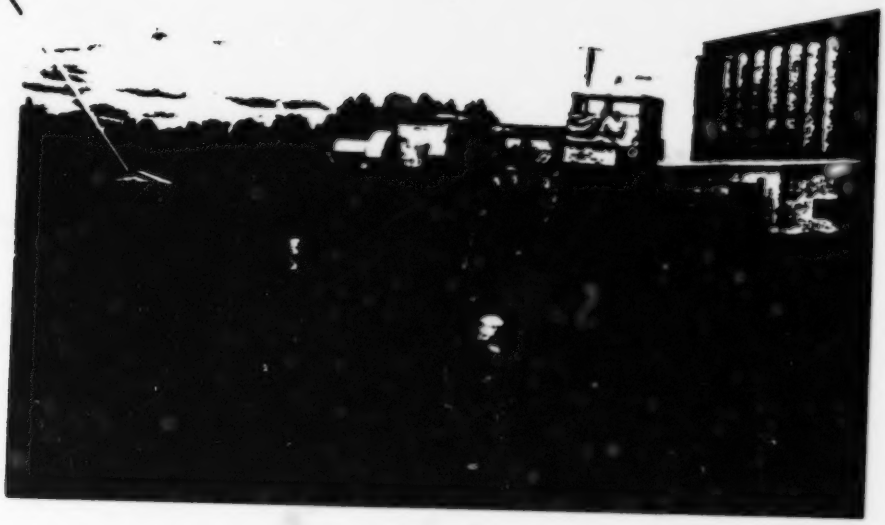
6.12 Plastic cards should be made up to be used as check lists for Pre-start, Operation, Shutdown and Running Maintenance. These cards would ensure safe operation and minimize human error.

7. GENERAL

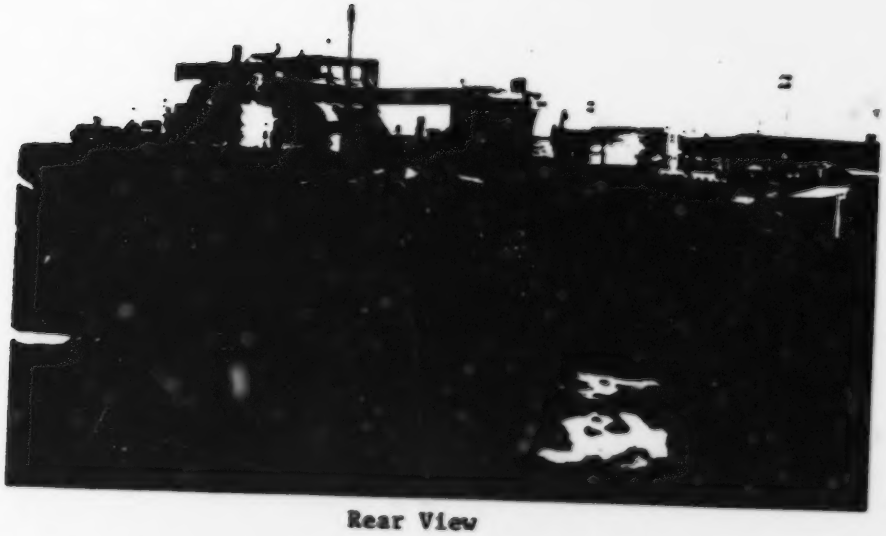
7.1 All the drawings for the craft should be updated to reflect the existing structure. There have been several changes/ modifications/repairs which have not been incorporated into the old drawings. This would greatly aid in repairs to existing systems and simplify further work carried out.

7.2 The ACIB does not have a repair and maintenance manual as such at the present time. A manual should be drawn up to reflect the craft as it stands; any additions or subtractions to the craft would simply be small amendments to an existing manual. At the present those personnel performing maintenance and operation have nothing to follow.

The ACIB as it sits on the beaching pad at Keefer Terminal 22 June 1982.



Front View



Rear View

Tachometers

Governor controls (throttles)

New lights for hydraulic system warning:

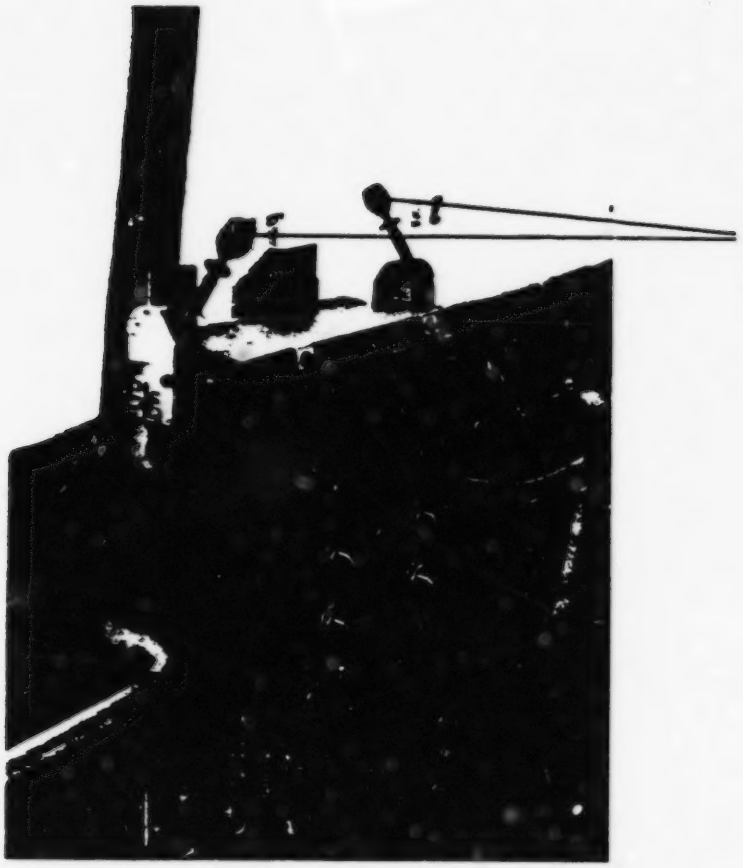
high pressure

high temperature

low level

- in that order

The Three Engine Control Consoles in the Howdah.
These three engines cannot be controlled at the same time by one person. To properly read the engine instruments a person must squat in front of each panel in turn. That person is completely blind to the outside when controlling and/or monitoring the engines during launch and docking.



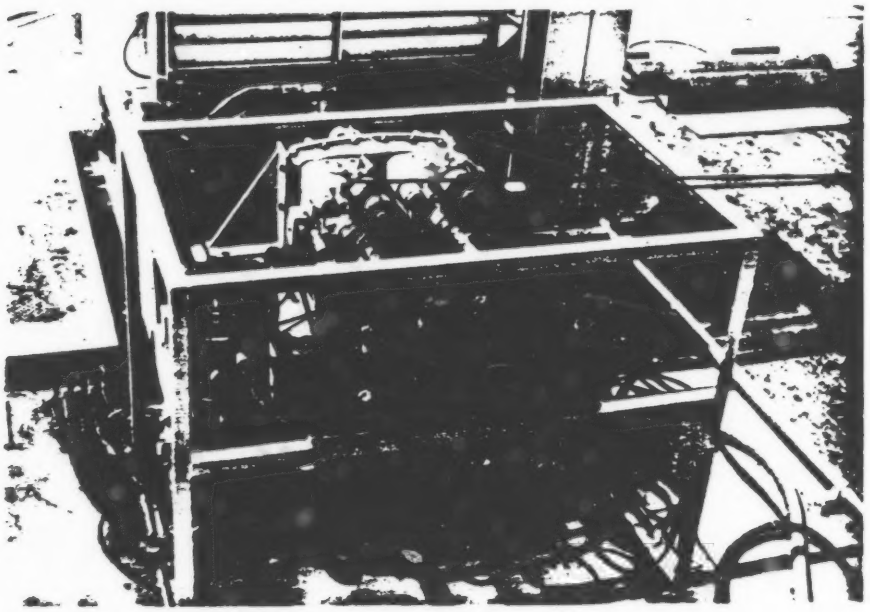
Winch Control Panel in Howdah

The present set-up allows for the winch control to be left in the position shown above. This could develop into a dangerous condition for the ACIB and/or the hydraulic system if the person in control is distracted from the winch control and leaves a winch in operation.

Starboard Transit and Notching Winch

The routing of the hydraulic hoses causes a walking and operation hazard the way it is located at the present. In the case of operation it is often necessary to run the transit cable out the front between the two bollards in the above picture. With the movement of the ACIB the cables chafe on the hydraulic lines.

The manner in which the brake valves are located on the winches invites trouble. It would be easy for someone to slip on the slippery deck in the winter and brake the valve off at its fittings thus disabling the winch.



Rusted filter casings.

Hydraulic Power Pack

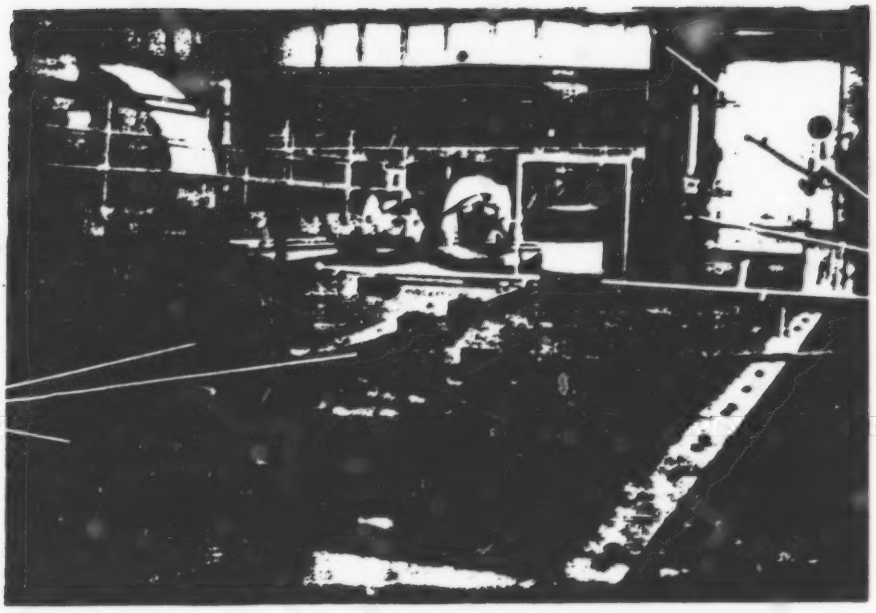
As seen above the frame around the power pack was painted to prevent further rusting. The reverse flow filter housings show signs of rust. The filters have no support at present. They rely on their own fittings for support. This could lead to complete failure of the hydraulics in its present configuration should a fitting break. All the fluid could be dumped on deck before the sytem could be shut down.

Fuel and Trim Ballast Tanks

At present, there is no proper method of fuelling the engine tanks from the emergency fuel tanks with the exception of gravity feed into the ship refuelling connection.

There is no means of quickly filling or dumping the water in the trim ballast tank. The tank holds 160 ft^3 of water and must dump it out a 2 inch gate valve. This takes about 15 minutes at present.

In the foreground are some of the shear blocks located around the deck. The sharp corners should be removed for crew safety.

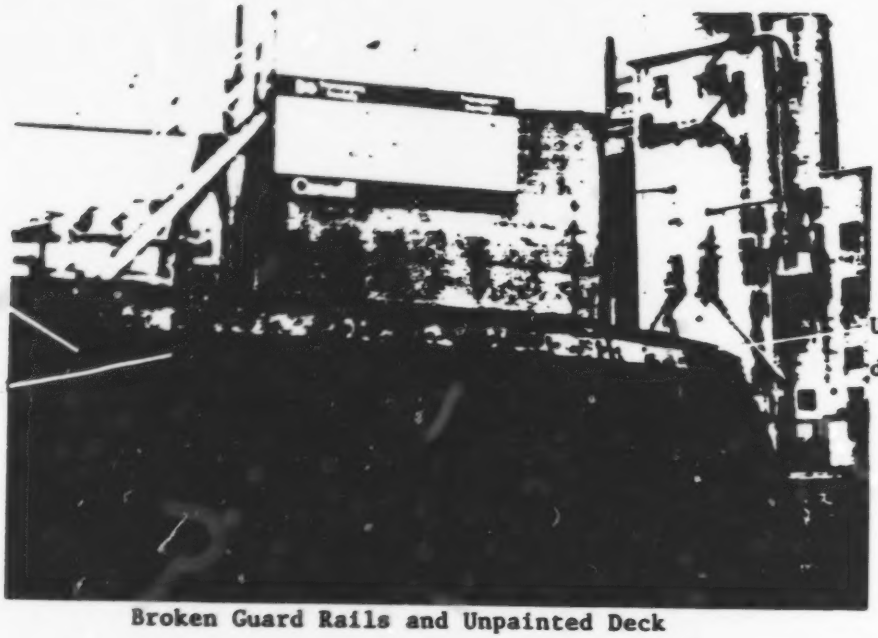


Shear Blocks and Unnecessary Bracketry

This is another view of the shear block arrangement on deck. Towards the left side is a series of unused brackets. For added safety these should be removed.

At present, there is no cover on the manual firing control head for the engine fire extinguishers. They are open to the weather and subject to being covered in ice to the point where they could not be fired by someone at the engine. This really could become a problem if there is an electrical failure.

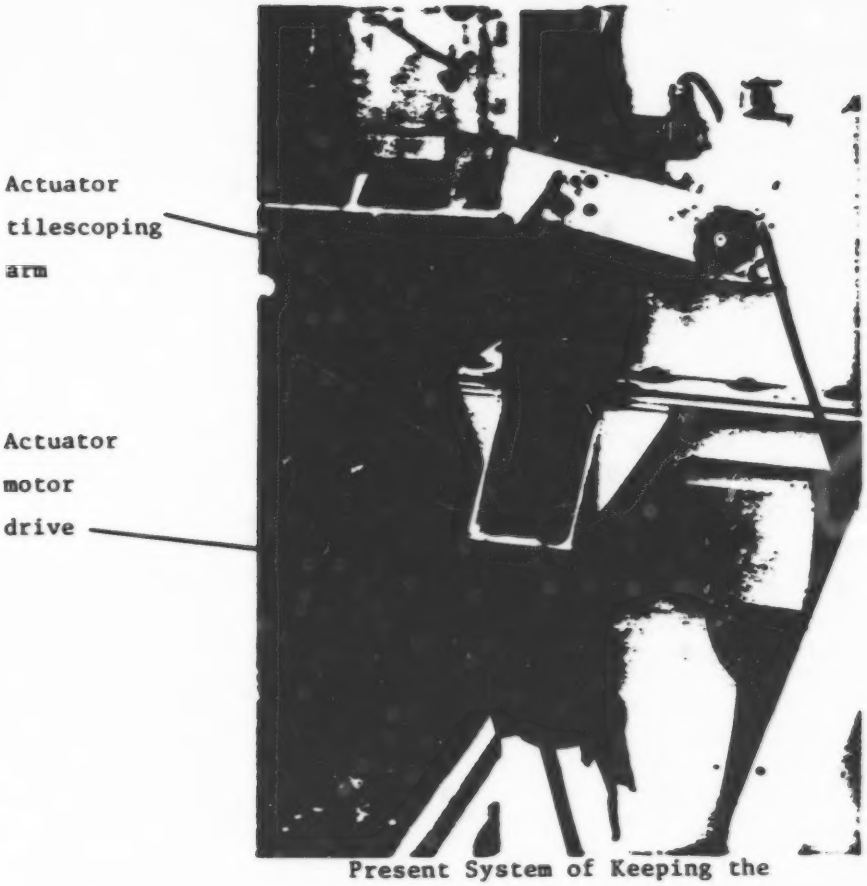
The rusted hydraulic piping indicates the need to have the ACIB completely examined and properly painted. This shows up even more in Thunder Bay because of the high humidity close to the lake.



Broken Guard Rails and Unpainted Deck

This picture again points out the need for a complete painting of the ACIB. As pointed out above there are areas of the structure that were not painted at all. Another example is the trusses inside the notch fingers. The notch will have to be disassembled then the entire notch and notch structure will have to be painted.

Due to the present design of the guard rail system a broken or bent guard rail post cannot be replaced without a complete set of cutting and welding equipment and a set of large pipe threading tops and dies. A problem with threading the pipe is that it weakens the post as well. The system needs to be redesigned so that repairs can be done quickly and easily with the mimimum of tools required. An example system could be simply a collar welded to the deck that the post could slip into, with a pin or bolt to hold the post in place.



Present System of Keeping the
Weather off the IGV Actuator

Shown above is a linear actuator used to open and close the Inlet Guide Vanes (IGV's) on the lift fans. In order to protect it from the elements the arm was coated with grease then covered with plastic. The motor drive was just wrapped in plastic open at the bottom. This was only a temporary measure and it is suggested that the arm be covered with an accordion-like rubber sleeve and the base be contained in a metal "sock"-like cover.

Inlet Guide Vane's and Protective Screen

As seen above the protective inlet screen was welded instead of bolted in place. This prevents any maintenance being carried out on the IGV's. This screen should be removed and bolted as per Howden Fan's design for this fan.

Notch Spray Skirt Chain Attachment Plate

Several of the notch spray skirt chain attachment plates have torn loose from the spray skirt on either side of the notch. This has been directly attributed to the fact that backing plates were not installed. On the areas where the plates had been installed there is no evidence of even minor tears in the rubber fabric. It is suggested that all attachment plates have backing plates made up and installed.

THE HYDRAULIC SYSTEM

The hydraulic winches can be operated from three positions using either the "Bow Engine" driving pumps # 1 and 2 or the "Starboard Engine" driving pumps # 3 and 4.

The positions are located at each set of winches and the remote controller located in the tower on the ACIB. (NOTE: There are no winch controls at the remote console which is located on the ship.)

THEORY OF OPERATION

Prior to starting up the hydraulic system the following checks must be carried out:

1. Check the oil level in both reservoirs. Gauge glass should be about 1/2 to 3/4 full.
2. The globe valves on the equalizer line between both reservoirs should be "opened" if both engines (starboard and centre) are started up.
   WARNING: Keep a very close check of the oil level in each reservoir for oil transfer. If it is noted that one reservoir is being filled and the other emptying, close the globe on the reservoir that is being filled, when the oil level in both reservoirs is equal, open the globe valve. Continue to monitor the oil level.
   When the starboard engine is run up and the centre engine is shut down, the globe valve on the equalizer line at the "starboard" reservoir is to be "opened" and the globe valve at the "centre" engine is to be "shut". Reverse the procedure when the centre engine is being run and the starboard engine is shut off.
3. Check that the globe valves at the port and starboard winches are "closed".
4. Check that four (4) red "emergency stop pushes" are pulled out. (One at each local station and two at the remote controller.)
5. Check that the four control levers are in the centre (vertical locked position).

WINCH CONTROL STATION

To operate the winches at the local station, is the same as operating from the remote control station with only one exception: set the control selection switches to winch at the remote controller. The winches can then be operated at the local control stations.

Set the winch control switch at the local station to desired winch "notch" or transit and move the control handle in the direction the cable is required to be moved.

NOTE: The port local control station will only operate the port winches and the starboard side will only operate the starboard winches.

REMOTE CONTROLLER

To operate the winches from the remote controller set the following switches to:

Control Position: Here (This is the control platform.)
Winch Selection: Notch or Transit
Engine Selection: Center or Starboard

NOTE: When one or both engines are operating the engine selection switches must be set to the same position. The winch selection switches do not have to be in the same position. e.g.: The starboard winch selection can be set to "notching" while the port selection switch is set to "transit" or vice versa.

Once the switches have all been set to their appropriate positions lift up the lock on the pump control handle and move the handle slowly in the direction required for paying out or hauling in cable. To payout cable on the starboard winches move the starboard pump control handle aft or away from the operator (i.e. point the handle in the direction you wish the cable to go). To haul in cable pull the handle slowly towards you. To operate the port winches use the port pump control handle and the operation is the same as the starboard.

The further the pump control handle is moved in either direction the faster the winches will turn. The handles must be moved to the centre locked position on completion of operating the winches.

HYDRAULIC OPERATION

1. Start up the centre, starboard or both engines.
2. Switch on the remote controller with the two key operated switches at the bottom of the panel and the two control position switches at the top of the panel and check that the green power on lamps light for the position selected.
3. At the hydraulic pumps check the pressure gauges. In the neutral condition the right gauges located at the reverse flow filters should read approximately 200-300 psi. The four gauges in the top of the pumps, one at each pump should read approximately 250-300 psi. The two gauges located, the reducting valves (RD1) should read "0" psi.

MANUAL OPERATION OF THE HYDRAULIC SYSTEM (Four men required for this operation.)

1. This mode operation is to be used only when the electrical system fails.
2. To operate the winches in the manual mode, certain conditions must be met.
   a) Either the bow, starboard or both engines must be running.
   b) The solenoids at the appropriate valves must be manually operated. (The solenoids remain in the position once shifted.)
3. See table below for selection of winches, solenoids, pumps and engines.

BOW ENGINE RUNNING

Winch Selection	Solenoid & Valve N^{os}	Pump Selection	Pump Location	Valve Location	Remarks
Notch - Port	1B, 2B, 4A, & 5B	# 2	Bow Engine - Inboard	Valves 1 - 4 incl.	Each valve is scribed with its appropriate N° and each solenoid is solenoid with the letter "A" or "B". Each pump have a control valve (NOOG) mounted on the side. On each pump control valve there is an operating butterfly lever, which is located on the top of the control valve and on the bottom of the opposite pump control valve.
Transit - Port	1B, 2A, 4B, & 5B	# 2	Bow Engine - Inboard	are located on the	
Notch - Starboard	3A, 6A, 7B, & 8A	# 1	Bow Engine - Outboard	Bow Engine	
Transit - Starboard	3A, 6B, 7B, & 8B	# 1	Bow Engine - Outboard	hydraulic unit.	
STARBOARD ENGINE RUNNING					
Notch - Port	1A, 2B, 4A, & 5A	# 4	Starboard - Inboard	Valves 5 - 8 incl.	
Transit - Port	1A, 2A, 4B, & 5A	# 4	Starboard - Inboard	are located on the	
Notch - Starboard	3B, 6A, 7A, & 8A	# 3	Starboard - Outboard	Starboard Engine	
Transit - Starboard	3B, 6B, 7A, & 8B	# 3	Starboard - Outboard	hydraulic unit.	

4. Once it has been decided which winch/es to be moved and the above conditions met, the operator will then move the butterfly control lever on the control valve at the appropriate pump. The direction of the winch movement will have to be determined by communication between the control valve operator and the winch handlers.

   E.G. To operate the notching winches on the port and starboard sides using the bow engines, solenoids 1B, 2B, 4A, 5B (Port) and 3A, 6A, 7B, and 8A (Starboard) should be manually shifted. The pump control valves at pumps # 1 and 2 must be operated by the butterfly lever so that each winch may rotate in the direction required.

MANUAL OPERATION OF THE HYDRAULIC SYSTEM (Four men required for this operation.)

1. This mode operation is to be used only when the electrical system fails.
2. To operate the winches in the manual mode, certain conditions must be met.
   a) Either the bow, starboard or both engines must be running.
   b) The solenoids at the appropriate valves must be manually operated. (The solenoids remain in the position once shifted.)
3. See table below for selection of winches, solenoids, pumps and engines.

Winch Selection	Solenoid & Valve N°s	Pump Selection	Pump Location	Valve Location	Remarks
BOW ENGINE RUNNING					
Notch - Port	1B, 2B, 4A, & 5B	# 2	Bow Engine - Inboard	Valves 1 - 4 incl. are located on the Bow Engine hydraulic unit.	Each valve is scribed with its appropriate N° and each solenoid with the letter "A" or "B". Each pump have a control valve (MOOG) mounted on the side. On each pump control valve there is an operating butterfly lever, which is located on the top of the control valve and on the bottom of the opposite pump control valve.
Transit - Port	1B, 2A, 4B, & 5B	# 2	Bow Engine - Inboard		
Notch - Starboard	3A, 6A, 7B, & 8A	# 1	Bow Engine - Outboard		
Transit - Starboard	3A, 6B, 7B, & 8B	# 1	Bow Engine - Outboard		
STARBOARD ENGINE RUNNING					
Notch - Port	1A, 2B, 4A, & 5A	# 4	Starboard - Inboard	Valves 5 - 8 incl. are located on the Starboard Engine hydraulic unit.	
Transit - Port	1A, 2A, 4B, & 5A	# 4	Starboard - Inboard		
Notch - Starboard	3B, 6A, 7A, & 8A	# 3	Starboard - Outboard		
Transit - Starboard	3B, 6B, 7A, & 8B	# 3	Starboard - Outboard		

4. Once it has been decided which winch/es to be moved and the above conditions met, the operator will then move the butterfly control lever on the control valve at the appropriate pump. The direction of the winch movement will have to be determined by communication between the control valve operator and the winch handlers.

   E.G. To operate the notching winches on the port and starboard sides using the bow engines, solenoids 1B, 2B, 4A, 5B (Port) and 3A, 6A, 7B, and 8A (Starboard) should be manually shifted. The pump control valves at pumps # 1 and 2 must be operated by the butterfly lever so that each winch may rotate in the direction required.

EYRETECHNICS LIMITED

MAINTENANCE INSPECTION CHECK LIST

FOR ACIB - HSL 533

A. PERIODIC MAINTENANCE CHECKS

And Checks Before Use in Winter Operations

Operation	Interval (Days)		
	1	7	30
1. Visually check engines, fans and winches	*		
2. Lubricate drive shafts		*	
3. Lubricate guide vane actuators and linkage		*	
4. Check hydraulic and fuel systems for leaks	*		
5. Check engine fuel filter bowls for water drain as required			
6. Check engine oil level and engine for oil leaks	*		
7. Check fan bearings oil level	*		
8. Hydraulic fluid visible in hydraulic tank fluid level gauge	*		
9. Inspect and lubricate winch cables			*
10. Check coolant level and system for leaks		*	
11. Engine heaters on	*		
12. Battery chargers for proper function	*		
13. Engine and fan intakes clear of debris	*		
14. Check fire suppression system			*
15. Check total electrical system			*

B. START UP CHECK

Check.

1. Battery circuit breakers on (in engine nacelles).
2. Oil dipstick for engine oil level. Fuel filter bowl for water. Drain as required.
3. No foreign objects on or around the engine.
4. Oil level in bearings on fans at proper level.
5. Battery on, green lights and all Distribution green lights on.
6. Fuel gate valve shut (turn on when docked to ship).
7. Fuel tanks have sufficient fuel.
8. "Platform" or "Ship" master switch selected on.
9. All winch controls off.
10. Press to test Warning system for each engine to be started.
11. Press to test Fire Warning system for each engine.
12. Engine-mounted master switch on Remote (unless engine is to be started from its own panel).
13. Inlet guide vanes closed (red lights on gauges indicating zero).
14. Inlet guide vanes switch set to Hand.
15. All engine access doors closed and secured.
16. Engine and fan intake cleared of personnel and equipment.
17. Cold Weather Starting Procedure

    NOTE: All cold starts (ie engines shutdown for more than 8 hours) should be done from the engine panels.

    17.1 Press starting motor switch firmly.

    17.2 Push the "Quick Start" button for two seconds then release it.

    17.3 Repeat the procedure if the engine does not start on the first attempt.

18. Normal Starting Procedure

18.1 Press starting motor switch firmly.

NOTE: If the engine fails to start within 30 seconds, release starting switch and allow starting motor to cool for about 1 minute before trying again. If the engine fails to start after 4 attempts, an inspection should be made to determine the cause.

C. AFTER STARTING ENGINES

1. Set each engine running at Approx. 900 RPM.

2. Check oil pressure normal.

3. Check water temperature indicator functioning.

4. Engine running light on. (green).

5. Charge indicator showing positive charge for each engine.

6. If engines started from their own panels, switch engine-mounted master to REMOTE and secure all access doors in the closed position.

7. Ensure all external power connections disconnected and removed.

D. COMING UPON CUSHION

1. Ensure engine water temperature at least 130°F (80°C).

2. Engine oil pressure normal.

3. Fan intakes clear of equipment and personnel.

4. Select I.G.V.'s on AUTO.

5. All overside connections cast off or secured as required.

6. Select all engines to 1200 RPM and allow skirts to inflate and stabilize.

NOTE: Do not run engines between 900 and 1200 RPM as this is the range for engaging the centrifugal clutch. Operation in this range for any period will cause the clutches to burn out.

7. Check vehicle is clear of obstacles, debris and personnel.

8. Check that all red inlet guide vane lights out and gauges reading fully open.

9. Select all engines to 1500 RPM.

10. After platform has stabilized select engines to desired RPM.

11. Check notch segments are fully inflated.

E. OFF CUSHION AND SHUTDOWN

1. Reduce the RPM of each engine to 1500, let the platform settle and stabilize then reduce to 1200 RPM and allow the platform to stabilize once again.

2. Set inlet guide vane control switch to HAND.

3. Close inlet guide vanes one at a time.

4. Run engines at 900 RPM for at least three minutes.

5. During this time, check and record oil pressure and coolant temperature.

6. Select each engine master switch off in turn.

7. Check that each engine running (green) light goes out and each guide vane closed (red) light is on.

8. If shutdown is from engine mounted panel visually check that inlet guide vanes are closed.

F. AFTER SHUTDOWN

1. Visually check engines, fans and winches.

2. Clear out winch bases and fairleads after each use.

3. Remove sounding plugs and check for leaks and record.

4. Check hydraulic system for leaks and fluid level. Top-up as necessary. Check fuel system for leaks and fuel filter bowl for water. Drain off water as required and top-up fuel levels.

5. Check fan bearing oil levels. Top-up as necessary recording amount added.

6. Check engine oil level, record and top-up as needed recording amount added.

7. Check all gauges and instruments including test circuits.

8. Visually check skirt condition outside and under ACIB.

9. Visually check complete notch system.

10. Where problems have arisen investigate corrective procedures. Record engine hours using engine hour readings only. Also record any and all deficiencies and corrective action taken if any.

MAINTENANCE CHECKS DURING NON-ICE-BREAKING SEASON

	Operation	INTERVAL (Days)	
		7	30
1.	Visually check engines, fans and winches	*	
2.	Check fan bearing oil levels. If ground power plugged in check engine block heaters for correct operation and battery chargers	*	
3.	Check engine oil level and for fuel leaks. Check engine fuel filter bowl for water. Drain when necessary	* *	
4.	Check coolant system and coolant level	*	
5.	General integrity check of skirts, notch and structure		*
6.	Inspect and check winch cables; lubricate if required.		*
7.	Check batteries and battery charging system		*
8.	General clean-up where required	*	
9.	Check hydraulic system and fluid levels	*	
10.	Check fire suppression system		*
11.	Start up and run up to operating temperatures pressures and RPM insuring that all inlet guide vanes remain closed.	*	
12.	With one engine running at 1200 RPM open inlet guide vanes of that engine only to inflate the skirts		*
13.	Check and record air leaks		*
14.	At time of run up check fan vibration levels	*	
15.	Check lighting systems and heating systems		*
16.	Check control systems		*

EYRETECHNICS LIMITED

SEND TO

FROM

VULCAN MACHINERY AND EQUIPMENT LIMITED

Serving the Construction, Municipal, Logging, Mining Industries

VUALL-1013

SUBJECT	REFERENCE	DATE
ACIB Sundstrand Relief Valves	TS24253	March 25, 1982

MESSAGE

This is to certify that all 8 relief cartridges on the closed loop Sundstrand Winch Drives are set at 2200 PSI, according to test procedures set down by Sundstrand Hydrostatic Transmissions, Ames, Iowa.

Trevor Vickery,

Hydraulic Services.

REPLY FROM

DATE

Wilson Office Specialty Ltd.

EYRETECHNICS LIMITED

REPORT ON THE HYDRAULIC SYSTEM FOR THE AC18

1. The hydraulic system has been completed on Saturday 20/03/82 with some defects. There is still an oil transfer problem from one reservoir to the other after the equalizer line was changed to the bottom of both reservoirs. Oil level monitoring must be carried out religiously when both engines are running and the globe valves opened at each equalizing line. The present system can be updated so that the hydraulic system is monitored at the ships remote console. Any future systems built should be simplified at a very low cost, in comparison to the existing system.

2. DEFECTS:

a) The system pressure is till high (2600 psi) and should be corrected by Port Shipyard.

b) The pressure gauges have lost their dampening fluid for pulsation protection, these should be refilled by the shipyard.

c) The filter elements should be opened and checked. At present the by-pass indicator on one filter element located on pump # 1 is showing the filter is by-passing. This element requires replacement.

d) All suction line strainers should be checked.

e) The equalizing line between reservoirs is temporary and should be replaced during the Summer months with a permanent line.

3. DESIGN DEFECTS:

The existing system have some design defects which should be corrected over the Summer months and some that must be incorporated into the system prior to the ice breaking trials.

a) Modifications prior to ice breaking trials.

i) Oil low level switches installed in both reservoirs with an alarm located on the ship's remote console.

ii) Oil temperature switch with a flashing red light located on the ship's console. Temperature 170°F.

...../2

b) Modification after ice breaking trials.

i) The winch operating levers at the local and remote stations should be changed to a dead-man lever (spring centered).

ii) Remote pressure indication at the ship's control console and at the ACIB's remote controller. This would give the ship's personnel an indication of possible winch creep if the pump control valve (M00G) is slightly off the null point.

iii) The oil reservoirs should have thermostatically controlled heaters (115 VAC - 60 Hz) plug in type. These will be used when the system is shut down.

iv) The four 1/4" hoses connected into the equalizer line should be routed back into the reservoirs. If the globe valves in the equalizing line are left closed and both engines are operating, there will be a back pressure in these lines causing a malfunction in the hydraulic system.

4. FUTURE SYSTEMS:

a) The existing system would have functioned adequately on two pumps of a higher gpm instead of four.

b) Any future systems should have two pumps with the same output. This would reduce the number of filters, relief valves, suction line strainers, hoses and fittings by 50%.

c) Both pumps should be supplied from one reservoir, eliminating the need for an equalizer line.

d) The four winches should be reduced to two. The transit and notching winches should be incorporated into one winch.

Any extra cables required can be supplied from the ship with the ACIB outfitted with bollards and fairleads to accept the extra cables.

e) The existing remote controller located on the ACIB should be incorporated into the ship's console. This would allow ship's personnel the capability of adjusting the notching winches without the need to go to the ACIB.

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f) The hydraulic pumps should be declutchable when not in use, this would prevent any winch creep due to a servo pump control valve not in the null position. If it is decided that clutches are required a permanent heater should be installed in the reservoirs to keep the oil at approximately 110°F. The clutching and declutching of the hydraulic system should be remotely and locally operated.

5. SUMMARY:

The need for some oil monitoring is required during the first set of ice-breaking trials. The existing system should be updated so that remote monitoring and control of the hydraulic system can be carried out with minimum danger to ship's personnel. Any future systems with the above ideas incorporated in these will simplify them and reduce costs drastically in comparison to the present system. The reduction in pumps, winches, reservoirs, etc., will also remove a lot of weight which would lower the ACIB's centre of gravity.

It must be noted that the existing system was set to work but not trialed. Such things as the winch brakes should be tested. At present there are no specification available for the winches. This trial can be easily performed while the ACIB is in the ship-yard.

The two helpers were trained by Pat Ambrose on Friday, March 19th, 1982, how to operate the hydraulic system manually, by shifting the solenoid valves and operating the pump control valve butterfly lever.

This function requires four men as the winches on both sides must be operated together. Speed control will be very difficult in this mode.

The voltage was measured for each winch control station and it is noted that in the out direction or paying out cable was 4 volts D.C.

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and in the in direction or hauling in cable the voltage was 3 1/2 V.D.C. The winch control lever at the starboard winches in the out direction the voltage was 4 volts and for the in direction it was 2 1/2 volts.

It must be noted that the winch speeds are slower in one direction than the other. This is because the centre tap on the potentiometer at each control station is not located directly in the centre. See drawing S-10355.

The hydraulic drawing GEC-1074 Collingwood shipyard does not show all the hydraulic lines fitted on the hydraulic system and the pressure setting for each relief valve. The hydraulic system is set to work in accordance with the electrical drawing S-10355 and the hydraulic drawing GEC-1074. The sequence of events should happen in accordance.

by PATRICK AMBROSE,
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Dated March 22, 1982.

POOR

QUALITY

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